THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893,

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ROSIN OIL AS AN INSULATOR.

UNTIL recently rosin oil has not occupied a very important nor dignified position. Although large quantities of it were manufactured, but little found its way into the retail market, at least, under its own name. It has chiefly been employed in the manufacture of printing inks and cart grease, and in the adulteration of other and more expensive oils. There is now, however, some probability of an increased, and, perhaps, a more legitimate consumption, of this oil taking place, owing to the discovery and proposed exploitation of its insulating properties.

Many vague and dogmatic statements, which ought to be dispelled, have been made concerning this oil since this new phase of its physical character has been recognised. It seems that its constitution is very variable, and we may presume, therefore, that its properties will not be constant. In a recent issue of the *Oil and Colourman's Journal*, which, we believe, justly stands at the head of the trades it represents, there was a very suggestive article on rosin oil, in which its chemical and physical properties were considered, and many important matters connected with its manufacture and employment discussed. Without following the writer through the strictly technical part of his paper, we may note several points which will be interesting to our readers.

In the first place, rosin oil is so called because it is the heavier portion of the products of the destructive distillation of rosin, which, in its turn, is the residue left by distilling crude turpentine, spirits of turpentine being the volatile portion. This oil is not of simple composition, for, besides hydrocarbons, it contains a proportion of certain organic acids. The more carefully prepared and refined the oil is the lower is the proportion of acids.

The specific gravity of rosin oil of commercial quality may vary between wide limits, *e.g.*, 0·98—1·10, while its action on polarised light is similarly variable, being generally dextro-rotatory, but sometimes lævo-rotatory, or nearly nil.

These and other facts which might be given are sufficient to indicate the variable character of commercial rosin oil; and the futility of discussing its electrical properties without defining the character of the sample under consideration, is tolerably apparent. In the various statements which have lately been made concerning insulation by means of rosin oil, the necessity of this has not been sufficiently borne in mind.

One of the most noteworthy characteristics of rosin oil is its great viscosity. This quality and its immiscibility with water, chiefly determines its applicability to the purposes of insulation. It is therefore plain that in addition to a purely chemical examination, the accurate determination of the physical property of viscosity should be undertaken. Thanks to the advances which have been made in the methods of

examining lubricating oils, there is now no difficulty in effecting this.

There is a further fact connected with rosin oil which seems to have been overlooked, namely, that when it is exposed to the air it undergoes change. How noteworthy that change may be has been opportunely illustrated by Mr. F. H. Leeds in a recent paper entitled "Notes on rosin oil," communicated to the London Section of The Society of Chemical Industry. The results of his experiments with three different samples of the commercial oil, conclusively demonstrate that after five months' exposure to the atmosphere a considerable amount of alteration in character was effected. Mr. Leeds also records and discusses other differences.

One deduction from this investigation is plain, namely, that a rosin oil may undergo profound alteration by exposure, and may easily alter in character to such an extent as to become more or less useful to a tangible degree. It can, therefore, never be safe to assume that because a specimen of oil has at one time given certain results under experiment, it will necessarily possess identical properties after a lapse of time, particularly if the conditions under which it has been kept have involved its exposure to the atmosphere.

This conclusion opens up a field for investigation in that not only do all kinds of rosin oil change, but that the tendency of different grades of oil to alter by exposure, varies greatly.

The writer of the article to which we are indebted, appears to think it probable that samples of rosin oil, consisting almost wholly of hydrocarbons, would prove the most resistant to change, and, if found to be also high in insulating power, as seems likely, would be preferable on that account. Experimental evidence is, however, much needed.

Perhaps the only satisfactory method of settling, once for all, the kind of rosin oil best fitted for the purposes of the electrical engineer, would be to examine the insulating capabilities of numerous samples and simultaneously to determine their chemical composition by analysis. If this were done, and it were ultimately found that oil could be advantageously used, as some of its advocates appear to think, there would afterwards be no difficulty in obtaining supplies of precisely the same quality as that grade which is found to be the most efficient. The manufacturer would be given a definite standard to work to, and could, by the aid of his chemist, match that standard as nearly as would be necessary.

"BETWEEN THE DEVIL AND THE DEEP SEA."

Lord Rosebery's position, as he described it when opening the new Polytechnic for South London last week, was certainly a most novel one. He said he stood, as it were, "between the Devil and the deep sea." Now, whether it was the promptings of the one, or the profundity of the other, we cannot tell, but something inspired him with the suggestion that the end and aim of the Institution should be "to raise the dignity of manual labour."

Every workman knows what Lord Rosebery means. When good work is done, the dignity comes by nature with it, and bad work brings discredit on his whole art and craft. A great deal has been said about the honour that surrounded the artisan of the past century, as contrasted with the indignity which seems to attend manual labour as seen by the youth of to-day. Our young men, Lord Rosebery observed, are degenerating into smaller clerks, "trying to earn misery at 16s. a week."

Allowing somewhat for the perspective, which always rounds off the corners of the past, and renders it more attractive than the present, there is still occasion to ask where, and at what time, did the indignity of artisanship come in. Is there any disgrace in turning a rough piece of metal into a beautiful machine? If not, why this deluge of clerks upon the earth?

The answer seems to lie in the fact that the work done to-day is of a distinctly different order to that of the famous old artisans, whose memory now is part of our romance. Division of labour robs the work of a good deal of its enjoyment, for the man does not see the finished machine, and thus loses much of the interest attached to it. He makes precisely the same thing every day—a spring, or a bobbin, or a disc—and he tends more and more towards an automaton.

Of course the "eminently conscientious" employer will suggest that an "eminently conscientious" workman ought to find the same dignity in making a bobbin as he would in constructing a steam engine; and whatever the monotony and whatever the surroundings of his work, he ought to find pleasure in it all. Perhaps such an employer is right, yet it is hard to imagine Antonius Stradivarius rejoicing as a peg-maker; or an Amati sitting down in ecstasy over a weekly piece-work of sound-posts. It is scarcely likely, either, that Palissy could have gone into raptures as a maker of fire-wood; and there is little wonder that he occasionally sought variety by anatomising his furniture.

Nevertheless, that monotonous and uninteresting work must be done is an absolute necessity at the present day; it is the direct consequence of competition. At the same time, we cannot express surprise that a greater proportion of young men do not choose artisanship as their calling. Why they become clerks is a mystery belonging to themselves and the age.

No one can deny that in many respects British workmanship is daily improving in artistic finish as well as in real efficiency; and we think that in this regard electrical manufacturers generally may be awarded, in the share of credit, something very near pre-eminence. Nor is there any doubt that this result is largely due to the influence of the technical colleges and artisan schools. It proves that even though a man is condemned to make one thing for all time, he will know better how to do it when he has comprehended the precise function it is to serve in the finished machine. If he wants dignity to follow his manual labour, he will always find it in proportion to the excellence of his work. A wife-and-family artisan will let the dignity slide as often as not, especially if he is poorly paid. Dignity counts for very little when a man's between the Devil and the deep sea, in that sense.

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A. R. Sennett on Smoke Prevention.

By W. H. BOOTH.

Amongst so much of non-practical value, Mr. Sennett's paper, read before the British Association, comes as a welcome change. Mr. Sennett understands the subject of smoke prevention, and deals with it well. He divides smoke devices into two main groups, viz., those for consuming smoke, and those for preventing it, the latter being, in his opinion, the more truly scientific method of facing the question. He divides each group into classes. Under the smoke consumption head he puts those devices first which seek their end by special flue arrangements, and instances a device whereby one-half only of a furnace being charged with fresh fuel, the evolved smoke is not allowed to pass direct to the flue, but its own flue is closed, and the gases pass to the flue proper to the other side of the furnace through a refractory partition. Secondly, those devices which pass the smoke through the incandescent fuel which has given them off, a most unpractical idea, as Mr. Sennett seems to think. Thirdly, devices for drawing in fresh air after firing, so as to mix with the smoke after it has left the furnace, and our author states that Sennett as either economical or effective devices for smoke prevention. Though we very much agree with this, we do know cases where they have proved eminently satisfactory in the hands of men who could and would spend time to look after them. He rightly condemns forced draught beneath the bars only as a source of increased smoke, and he is evidently afraid of the cooling action of the boiler itself upon the freshly-evolved gases; but the point of interest in his paper is his strong advocacy of the necessity for the presence of steam in a furnace.

In many chemical operations, it is found that the presence of a small quantity of some vapour is necessary for success, and yet this modicum of vapour is not used up; it remains; its purpose is merely to act as a carrier. Thus, in the leaden chamber of the sulphuric acid manufacture, a small volume of one of the oxides of nitrogen is found necessary to effect the union of the constituents of the acid, but there is no consumption of the gas which acts as the carrier.

Now, it has long been recognised by practical men that wetting coal is beneficial.

Mere superficial theorisers will tell as that it is a gross error to use wet coal, because every pound of steam formed in the furnace means a pound of steam less in the boiler.

But practice teaches us that we may damp our coal with advantage, and in France, where fuel is dear, they will use mere dust coal, like flour, and wet it, so that it can be fired

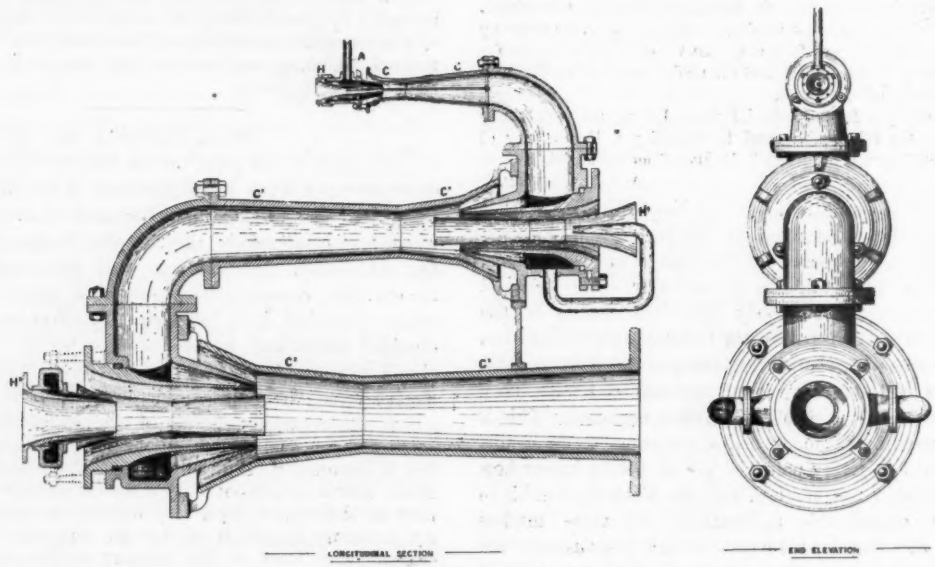


Fig. 1.

he has found intense local heating to arise from air admission at the bridge, while the efficiency of the boiler was reduced.

In class 4 he places those devices which do not attempt to prevent or consume smoke, but to destroy it by means of water.

Under the head of "Smoke Prevention," he puts in Class 1 devices for admitting air for admixture with the gases as evolved in the furnace, as through the fire-door by means of a hand or automatically regulated register. In our own experience of these devices, we would state here that usually the air openings allowed in the fire-door are much too small for supplying air just after firing, and much too large to be always open, while it is impossible to get many firemen who will use them properly. Broadbent's automatic louvre, with escapement regulator, acts well for the purpose, for it is arranged to admit a large quantity of air after fresh firing, and automatically shuts off the supply to nothing as the coal becomes coked. But this device will not act when the natural draught of the furnace is less than about 15 feet per second. Below that velocity the air will not enter in sufficient quantity without the aid of an inducing jet of steam. This steam jet our author puts in class 2, and he then proceeds to state that he had found no device which secured its aim, and did so without diminished efficiency of boiler and waste of fuel when ordinarily stoked. We cannot quite endorse Mr. Sennett in this last statement.

Mechanical stokers do not commend themselves to Mr. like so much wet sand adhering in a mass, and not being blown into the flues as dust, and with this fuel they get excellent evaporative results. Mr. Sennett refers to experiments by Mr. Brereton Baker, who sealed up carefully dried powdered charcoal in test tubes with dry oxygen and with moist oxygen. When these tubes were heated over a Bunsen, the dry tubes showed no combustion, though heated to redness; but in the damp tubes the carbon burnt with bright scintillating flashes, showing the need for the presence of moisture.

Again, Prof. H. B. Dixon states that a dried mixture of carbon monoxide and oxygen ceases to be explosive, though ordinarily it would be markedly so, and even a burning jet of carbon monoxide will be actually quenched in dry oxygen. The author experimented with a smoky coal, and burned 2,825 lbs. of coal in 10 hours on a grate, at the rate of 20·4 lbs. per square foot per hour and with natural draught, and he had left 85 lbs. of ash and 109 of clinker. Next day, with a steam jet, he burned 2,325 lbs. of coal, and only produced 59 lbs. of ash and 20½ lbs. of clinker, and he made no smoke though he had made smoke the previous day. To keep going on the first day, it was necessary to clinker every three hours; but on the second day not until the end of the test was any clinker removed. He can account for the reduced weight of ash because it was found to contain less unburned carbon, but he cannot explain the reduced clinker.

This, to our idea, is due to the easier oxidation in the presence of steam of the iron, &c., which form a considerable percentage of most, or all, furnace clinkers.

Sir Lothian Bell points out that blast furnace gases at 250° to 300° C. are not inflammable in the atmosphere, and yet if a tuyere begins to leak, they will at once take fire. All these are important facts, on which our author rightly lays

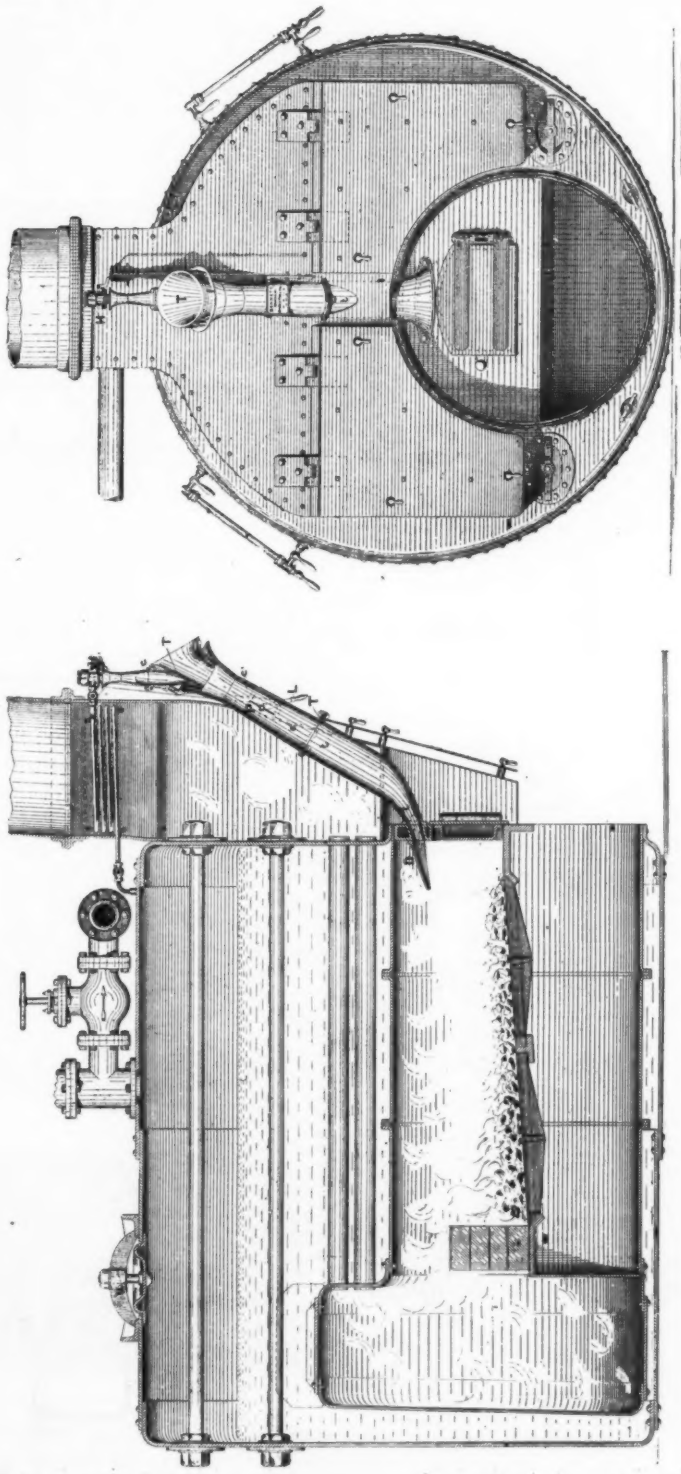


Fig. 2.—Application to Marine Boiler.

considerable stress before passing on to urge the importance of thoroughly mingling all introduced air with the gases to be consumed. This is a point long recognised and insisted upon by smoke preventors of any pretence to reliability, and its acceptance is indicated by the use of perforated plates in furnace doors for the purpose of breaking up the entering stream of air into many little jets. He then enumerates seven conditions essential to smokelessness briefly as follows :—

1. Air impelled into furnace above fuel.
2. Thorough admixture of air with evolved gases.
3. Distribution of the mixture over the incandescent fuel on the bars.
4. Avoidance of contact with cold plates of boiler.
5. Space for expansion of gases (? after combustion).
6. The air added over the fuel should be at least half that admitted *viâ* the bars.
7. Presence of steam in excess of that produced from the coal itself.

The present writer practically agrees with all the foregoing,

and has been accustomed to insist on four conditions, with a rider, which substantially include all the above seven, and these four conditions are :—

1. Admission of air at the door above the fuel in volume proportionate to the bulk of hydro-carbons evolving from the fuel.

A fifth condition, or rider, was a sufficiency of draught to supply the air at the door, to be obtained by a steam jet, if necessary.

These conditions are of some years' standing, and have formed the basis of much successful practice in Lancashire and Yorkshire ; but the admission of steam has not been

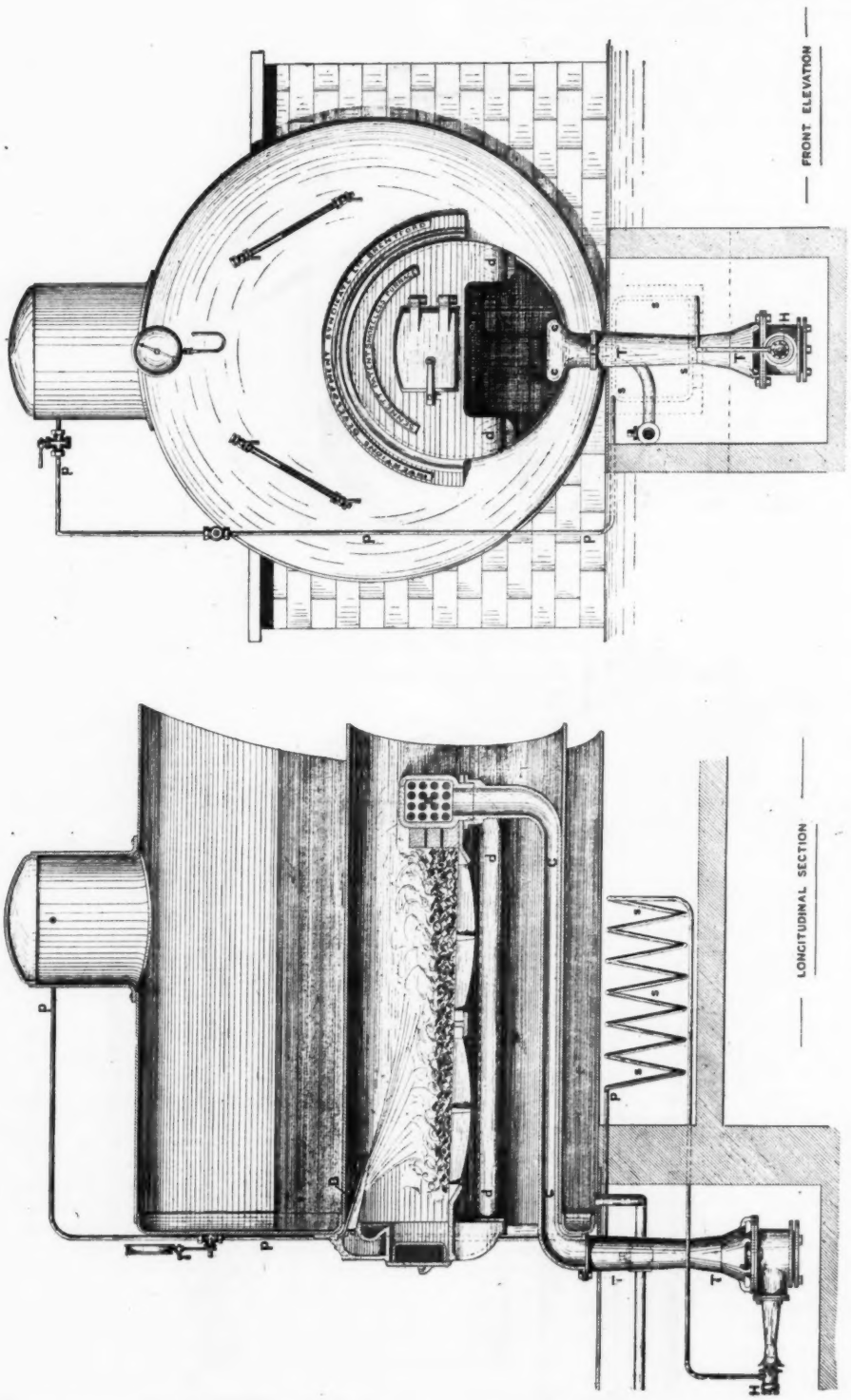


Fig. 3.—Application to Cornish Boiler with Bridge Superheater.

2. Thorough admixture during the passage to the bridge of the mixture over the fuel bed.

3. A temperature of 1,000° Fahr. when the mixture reaches the bridge.

4. A free space beyond the bridge in which the mixed gases may complete their combustion unimpeded by water pipes, &c.

accorded the weight now given it by Mr. Sennett, although its beneficial effects have been much recognised. The remarkable effect of a small admission of steam—a mere dribble of no forward energy—is sometimes most interesting, causing a sluggish burning fire to leap into a roar.

Mr. Sennett, for his experiments, wanted a large volume of air, and he devised the arrangement of fig. 1, wherein a

fine jet of steam enters an injector head, H, at A, through an annular orifice of $\frac{1}{50}$th of an inch area at most, and passes forward with an induced supply of air to the second head, H_2, and then again to H_3, every transformation down in speed adding to the volume of the induced air current; though, ordinarily, a single transformer would be sufficient.

In all experiments he has had tried with this apparatus, he has found economy and smokelessness to result. He found no additional benefit from highly super-heated steam or from highly-heated air; indeed, a slight loss in the latter case. Though we are glad to see the question taken up by Mr. Sennett, it would be unfair not to call attention to the fact that air admission above the furnace at the door is a quarter of a century old, to the present writer's knowledge, with automatic adjustment for reduction as the smoke gradually reduces as the fuel cokes, whilst the steam jet is also as old, or older; though, as we say above, there has not been that weight attached to moisture as a chemical agent, but rather a tendency to jeer at its advocates, many of whom, though right in their estimation of its effects, would ignorantly explain the effects as being due to the combustion of the decomposed steam, which they would persist in treating as a fuel—a manifest absurdity. The newer view of water vapour as a carrier lends additional interest to the question, and Mr. Sennett is to be thanked for the neat manner in which he has focussed the whole subject. Mr. Sennett, too, objects to the use of a direct steam jet, hence his apparatus.

A STUDY OF THE INFLUENCE MACHINE.

By J. E. TAYLOR.

The action of a few influence machines is here proposed to be studied, principally from a consideration of the dielectric strains in the different parts of their electrostatic fields, these dielectric strains being represented by lines of induction or strain.

A modern high tension influence machine may be described as a means of straining the surrounding dielectric electrostatically, by a purely mechanical process, up to its breakdown point. To follow out this process, it is desirable to consider the elementary meaning of a line of strain, and to consider the distribution of the lines in one or two simple cases of induction. The properties of these lines of strain have been discussed in the Electrical Review, under the heading of "Electrostatic Induction,"* and it will now be sufficient to define such a line as an indication of the existence of a strain. Although this is the whole of its meaning, yet the nature of the strain is such, that the line may be supposed to have a real tangible existence. It is a line which always tends to contract itself with a force proportional to its length, and which may be elongated or stretched out by separating the bodies to which it is attached. Thus, suppose A and B to be two conductors between which a strain exists (fig. 1).

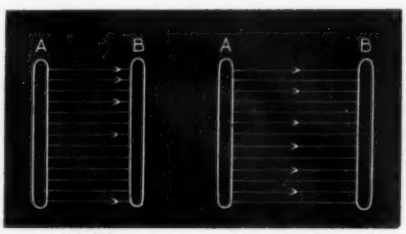


Fig. 1.

Fig. 2.

Then, assuming that the strain could exist only in that part of the dielectric between the conductors as shown, it would be possible to draw out the lines of strain to any length by simply separating the conductors to a greater distance, and the elongated lines would still exactly represent the state of the field (fig. 2). In practice, however, the lines of strain are so distributed that it is only for very small distances apart of the two conductors that the action can be so regarded, a matter which will be touched upon later.

The mental conception of an electrostatic strain, brought before the mind by a consideration of the more prominent phenomena, is that of a molecular distortion produced by two forces tending to separate the components of the molecules. Thus, supposing two atoms constituting a molecule have forces normally keeping them in a certain position relatively to one another, then on straining the dielectric containing this molecule, the distance between them is forcibly increased, the agency by which the force is exerted being undoubtedly the ether attached to, and intimately associated with, matter. The true state of affairs is certainly not so simple as that just indicated, but it is a mental analogy undoubtedly correct in its main features, as may be seen by taking into account the following phenomena, among others:—

(*a*) On electrostatically straining gases up to the breakdown point, the discharge or release of the strain (which means a collapse of the dielectric along the path of the discharge) produces decomposition, just as liquid solutions are decomposed by a current.

(*b*) On the collapse of the dielectric taking place (in any form of spark discharge), there are a number of reflex actions, showing that the normal condition is assumed only after a number of oscillations of the displaced or distorted parts. This is an action which may take place over the whole of the strained dielectric, as in the case of a Leyden jar discharging under the now well-known conditions of the circuit as to resistance, &c.

(*c*) Generally speaking, an electrical strain does not affect the volume of a dielectric, as would be the case if it tended to separate the molecules from one another.

The distortion in any one molecule is a function of that in every other molecule of the dielectric, so that there must evidently be a connection of some kind from molecule to molecule. This connection is the ether.

It may be as well, before going further, to point out clearly what has been hitherto implied, viz., that the lines of strain representing an electrostatic field are supposed to be the edges of the longitudinal sections of the *columns** of strain, and that these columns represent volumes of the dielectric containing equal amounts of energy of strain, whilst at the same time they indicate the resultant direction of the straining force in the dielectric. The energy in any column is the quotient $\frac{l}{a}$, where l is the length, and a what may be called the average cross sectional area of the column, and by the above definition $\frac{l}{a}$ is necessarily constant for all columns between the same conductors.

Having formed a conception of static strain, it will be easy to follow out the distribution in one or two cases of induction.

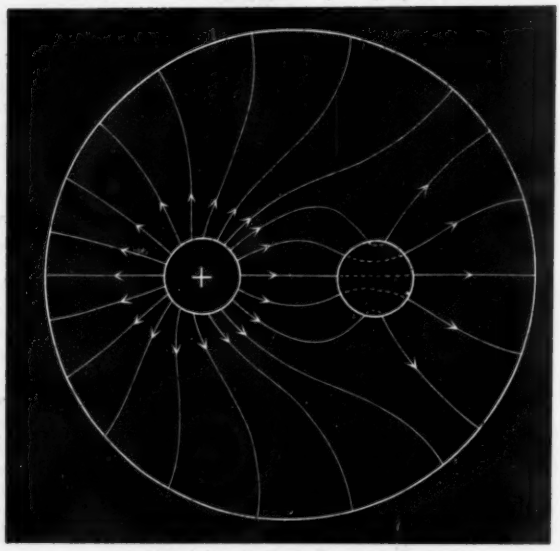
What is termed induction is simply a partial short-circuiting of the lines of strain of a charged body through the body which is acted on inductively. If a conducting body be placed in an electrotstatic field, the immediate distribution is just as if the body formed part of the dielectric, the lines of strain extending through its substance. Next, the lines inside the conductor collapse, and then a re-distribution takes place over its surface, for now the lines must adjust themselves normal to that surface. After such re-distribution of the initial lines, we may consider a total re-arrangement of the whole field as resulting, on account of the strain in any one part being a function of that in every other part. At the end of this total re-distribution the static field is at rest again, the whole action occupying a time dependent on the resistance and capacity of the body and the number of unit lines in the field. The induced body thus cuts the lines which touch it into two sets, one side of the body being the terminus of inward or negative lines, the other side that of an equal number of outward or positive lines.

The processes by which the strain in a dielectric is increased may very conveniently be considered under two headings. Calling the energy of the strain $\frac{l}{a}$ as before, it is

* See Electrical Review, July 31st, 1891.

* See Electrical Review, Vol. xxix., p. 136.

evident that we can increase this energy either by increasing l, or by decreasing a. It is convenient when increasing l to bring into play auxiliary conductors, by means of which we may subdivide the lines as pointed out in the case of the in-



Induction of charged sphere on uncharged sphere

Fig. 3.

duction of one sphere on another. The reason why this is convenient is that we may utilise the surplus energy without neutralising the whole field, as will be readily understood on a consideration of the action of the electrophorus. A theoretical case of the first kind is that which follows; an action which may be described as the sub-division and multiplication of lines of strain. A and B are two conductors between which a strain exists. Into the static field between these conductors, after elongating the lines by separating the conductors to a greater distance if necessary, are introduced two similar conductors in contact with one another, as in fig. 4.

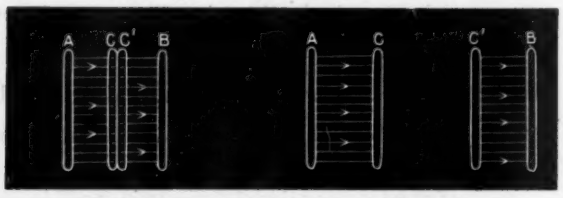


Fig. 4.

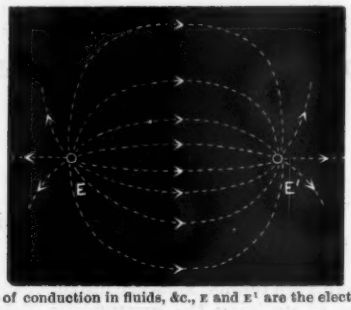
Fig. 5.

This divides the initial lines into two sets, and, indeed, the initial field into two independent fields for the conductors, A and C, and B and C′, may be paired off into two sets, each identical with the first set composed of A and B and the intervening field. Upon each of these sets, by the aid of more auxiliary conductors the same operation may be repeated, and so on, *ad infinitum*.

Or, without the use of more auxiliary conductors, the strain between B and C′ may be utilised for any required purpose which causes it to be neutralised, and then the conductors, B and C′, introduced into the field between A and C, giving a fresh supply of strain (between B and C this time). Thus, one field may be used as an unfailing reservoir into which to dip for the means to develop more energy of strain.

As pointed out in the beginning of this article, the action can only be accurately regarded as explained above, when the distances between the respective conductors, in proportion to their areas, are very small. When these distances are considerable, only a small part of the total lines enter into the action, which is consequently feeble. And not only this, for after a certain distance intervenes, the separation of the conductors is nearly as effective in increasing a as in increasing l. In fact, if the conductors are isolated in space, the farther we separate the conductors, the more and more nearly does the quotient $\frac{l}{a}$ remain constant, owing to the continual increase of the rate at which a increases for a given increase of l; the limit of increase of rate being when it is equal to the increase of l. And if they are not isolated in space, but enclosed by, say, the walls of a room, then, as they are separated, l reaches a maximum, and then begins to decrease again as the walls are approached, a varying at the same time in such a way, that the quotient $\frac{l}{a}$ reaches a maximum, and then begins to diminish, following a law dependent on the positions of the surroundings of the conductors.

This is, in fact, an exactly analogous case to that of fluid resistances. Thus, if two electrodes be immersed in an unlimited quantity of conducting fluid, we can represent the current flow through the liquid by *lines of conduction*, which are the exact counterpart in the liquid of lines of strain in a dielectric. These lines map out (in section) portions of the liquid which carry equal currents, whilst at the same time they indicate the directions of these subdivided portions of the current. Therefore the resistances of each portion of the liquid thus divided up are equal to one another. That is, $\frac{L}{A}$ is constant, where L is the length of any one path or portion, and A a cross-sectional area of the same, which may be called the average cross-sectional area; because the resistance is directly proportional to the length and inversely to the sectional area.



Lines of conduction in fluids, &c., E and E' are the electrodes.

Fig. 6.

If the distance apart of the two electrodes is great in proportion to their size, then the increase of resistance between the electrodes on increasing the distance between them to any extent is negligibly small.

In determining the truth of this theorem experimentally, we require to use a fluid which does not give rise to much polarisation, as the resistance would otherwise appear very variable. An ordinary bichromate solution gives very good results with electrodes formed by stripping the copper conductors for a short distance from the ends of their impervious insulating coating. It is also advisable to arrange the bridge for testing so that a high resistance is kept in series with the fluid, to use small battery powers, and to keep the battery circuit closed. If more convenient, of course alternating currents and a telephone could be used. The former arrangement, however, gives a very constant resistance and demonstrates the truth of the theorem well. Thus in a shallow trough, with only 1 inch depth of liquid, 3 inches wide by 8 long, two thin wire electrodes measured 13·5$^{\omega}$ at a distance of 0·5 inch; the same at a distance of 1·0 inch and 14·5$^{\omega}$ at 2·0 inches, the latter increase being fully accounted for by the interference due to the dimensions of the trough. This analogy of fluid resistances is a very useful one in many ways. The resistance through the earth between earth plates of telegraph circuits, &c., follows the same law and forms a well-known illustration of this theorem, inasmuch as this resistance does not increase appreciably with the distance between them after a certain limit of distance is passed.

The second process by which the strain in a diclectric may be increased is by decreasing a in the expression $\frac{l}{a}$. This is brought about by a superposition of electrostatic fields.

It is well known that when two similarly charged bodies (*i.e.*, bodies at which similar ends of a set of lines of strain terminate) are brought within range of one another, their mutual action is to raise one another's potentials. This rise of potentials is dependent on the distances between the bodies,

being negligible at large distances, and is due to a decrease of sectional area of the columns. Thus, in figs. 7 and 8, A and B are two similarly charged spheres. When at some distance apart many lines curve round so as to terminate on the inner sides of each sphere (a fact admitting of easy proof, and almost self-evident), but as they approach one another this curvature becomes less and less, and, finally, almost disappears. Consider the effect on the cross-section of the columns. In fig. 7, that for some little distance out from either body is practically unaffected by the other body's lines, but as the curvature becomes less, so does the cross-

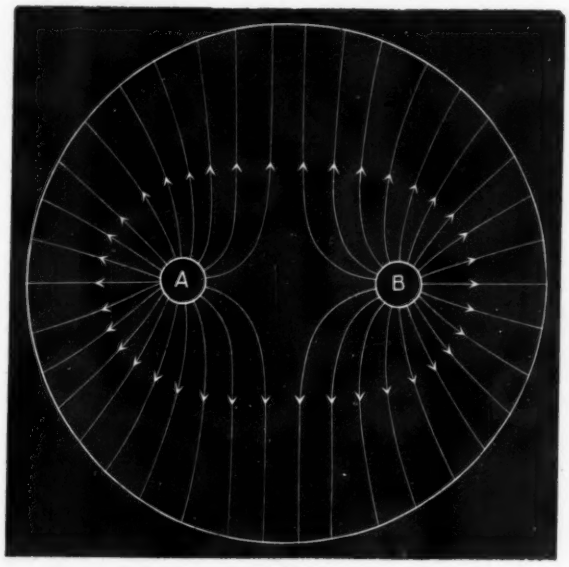


Fig. 7.

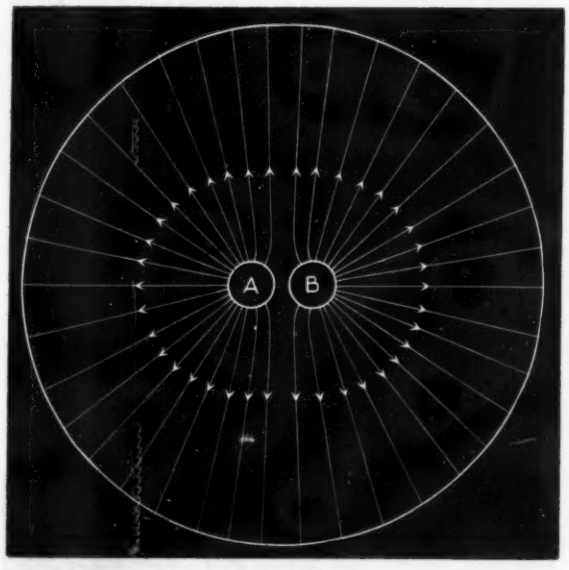


Fig. 8.

section near each body, that is $\frac{l}{a}$ gets larger, meaning increase of strain. The action will be more readily understood if the bodies, A and B, are imagined to be much smaller than those shown in the figures, which are shown large for the sake of clearness in detail, and more effective if flat vertical discs are used with their plane surfaces opposed.

Take another case of superposition of fields, differing from the foregoing in that symmetry is wanting either through one body having a larger charge than the other, or being of a smaller size. Either amounts to the same thing, as far as principles are involved. Let one of the bodies be a flat disc, and the other a small sphere (fig. 9). In this case the potential of the sphere, as approach takes place, tends to rise much more rapidly than that of the disc (owing to its smaller capacity), thus establishing a preponderance of the strain in any one column emanating from the sphere, over any one emanating from the disc, or, in other words, causing a difference of potential between the sphere and disc (assuming each to have the same potential when apart).

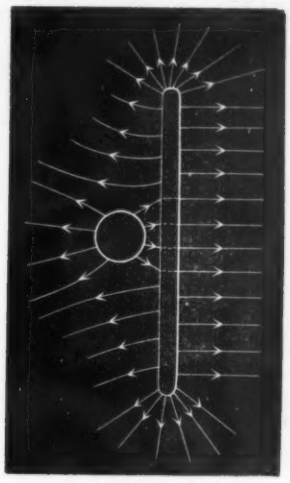


Fig. 9.

The sphere, therefore, can project some of its lines through the disc just as in the case given previously of a charged sphere acting inductively on an uncharged sphere. Now, imagine this disc to become concave on the side next the sphere and convex opposite, to bend into a hemispherical shell round the sphere, in fact, as in fig. 10. As this shell

Fig. 10.

more and more completely encloses the sphere, the capacity of the latter grows less and less in proportion as its lines of strain are hindered from spreading by those of the shell, until at last, when completely enveloped (fig. 11), it has decreased to just the extent necessary to enable it to project the whole of its lines through the shell, the superposition of the two fields being thus complete.

The lines extending from the sphere to the shell may, of course, be neutralised by contact between the two, and thus we have the complete explanation of the total absorption of charge on placing the charged body inside a hollow conductor, however highly that conductor may be charged.

It may be noted that this case of a charged conductor, enveloped by another conductor, is the only instance of a charge being induced by one body on another body, equal to the charge on the first. In all other cases, some only of the lines pass through the induced body. It has recently been assumed that a body can induce even more than its own charge on a body which does not by any means envelop the first, as will be explained when the action of the Wimshurst machine is treated of.

Having had occasion to use the term "difference of potentials," it will conduce to clearness to state decidedly that this is always simply a result of the existence of strain. It is almost universally treated of as though the effect or strain in the dielectric was a result of this difference of potentials, causing to the amateur, at least, a good deal of unnecessary haziness.

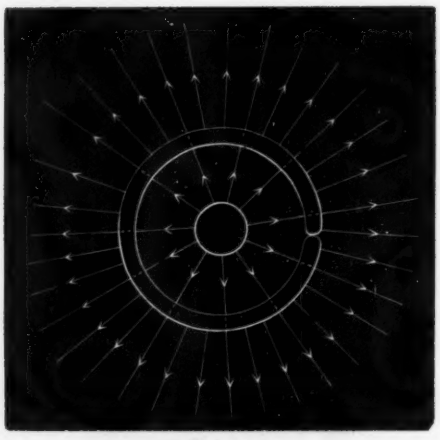


FIG. 11.

In cases where the lines of strain are parallel to one another, the value a is self-evident, since there is only one cross-sectional area. It will be as well, however, to work out its value in the next simplest case, that of radial lines, where

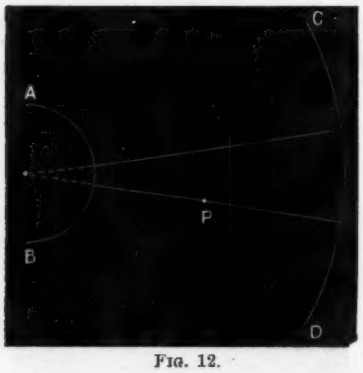


FIG. 12.

it can hardly be said to be self-evident. Thus, let A, B, and C, D, be two concentric spheres of radii, r and R respectively. The strain in any molecule of the dielectric at a point, P, is inversely proportional to the size of the segment of the area of the equipotential shell in which it happens to be. This area is directly proportional to the square of the radius of the shell, say x^2, and therefore the strain is $\frac{1}{x^2}$. The sum of the strains in each molecule along any radius is :—

$$V = \int_r^R \frac{1}{x^2} \, . \, dx = \frac{R - r}{R\,r} = \frac{l}{R\,r} \qquad (1)$$

V being the difference of potentials between the ends of any line, that is the sum of the strains along that line. If C be the capacity of the system, we have :—

$$C = \frac{a}{l} \qquad (2)$$

$$C = \frac{1}{V} = \frac{R\,r}{l} \qquad (3)$$

$$\therefore \frac{a}{l} = \frac{R\,r}{l}$$

$$a = R\,r = \sqrt{R^2\,r^2}$$

But R^2 is proportional to the segment of area of the outer sphere, and r^2 to that of the inner. We may therefore say that a is the geometric mean between the maximum and minimum areas, and is part of an equipotential shell cut off by the outside of the column.

If R be made equal to infinity, then—

$$V = \int_r^\infty \frac{1}{x^2} \, . \, dx = \frac{1}{r}$$

$$\therefore C = r$$

a very simple proof of the well-known law that when a sphere is at a considerable distance from all other bodies its capacity is proportional to its radius. It may be mentioned that the same law holds for fluid resistances, that is, when the electrodes are far apart, the resistance of the liquid is simply proportional to the diameters of the electrodes, and exactly the same reasoning applies to either case.

It does not require a mathematical proof to see that so-called "repulsion" is in all cases the effect of attraction. Thus, referring to figs. 7 and 8, where we have a case of repulsion between similarly charged bodies, it is easily seen why the apparent force of repulsion becomes greater as the bodies approach one another. It is because the lines of strain distribute themselves more over the outer surfaces and therefore act so as to pull the two bodies apart. The great stumbling-block to this view of the matter has always been that because of the distance of the bodies from the attracting matter it would be supposed that such attraction would be very weak. This, however, is not the case unless there is other attracting matter much nearer; in fact it is rather the other way about, that is, each line exerts a greater force between its ends on account of its increased length, and if all the lines could be got to act uniformly in one direction, the apparent force of repulsion would be much greater than any other manifestation of the force of attraction due to an equal charge.

Before entering into the action of the influence machines themselves (of which a few of the principal forms only will be treated), there is another effect of induction in connection with them which has been already described in the ELECTRICAL REVIEW,* and which is generally very ill-understood. It is an effect due to dielectrics of different strengths being involved in their action, and is the key to the explanation of the most striking of Tesla's and others' experiments.

The strength of the electrostatic field necessary to produce a discharge or collapse of the strain in a dielectric varies within very wide limits with the nature of the dielectric; its power to resist the strain having been called its *dielectric strength*. Thus, calling the dielectric strength of air at the normal atmospheric pressure, unity, that of partial vacuum varies according to the degree of exhaustion to probably much less than $\frac{1}{100}$th, whilst increase of pressure rapidly increases the dielectric strength. Liquid dielectrics, such as oils, are all considerably more than unity, and, in some cases, probably better than common glass. Solid, homogeneous dielectrics, as good toughened glass, have, perhaps, the very highest dielectric strength. If then a compound dielectric, composed of dielectrics of different strengths, have a uniform electrostatic field projected through it, and the strength of this field gradually increased, the weaker parts will give way first, and so on.

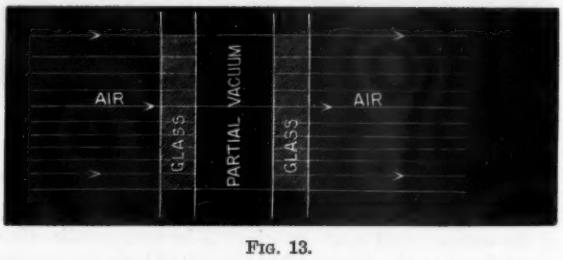


FIG. 13.

The effect of overstraining a dielectric is to cause the strain to collapse in the shape of a discharge of any kind (spark, brush, or glow), and if the weak dielectric be surrounded by a stronger dielectric, a discharge *without electrodes* is the result. Fig. 13 gives a diagrammatic representation

* ELECTRICAL REVIEW, Vol. xxix., p. 135.

of such a case, where a field has been projected through three different dielectrics, air, vacuum, and glass, and increased in strength up to that indicated by the transverse lines through the glass. The original continuations of all these lines through the air and vacuum are, for the most part, collapsed, the resultant field being that indicated in the diagram. Next, let the direction of the field be reversed, that is, let it be an alternating electrostatic field, then at each alternation a fresh discharge of double the duration or intensity, however, will take place, due, in the first place, to the release of the former strain in the glass, and, in the second place, to the formation of a fresh field. This is the complete explanation of the continuous electrodeless discharge obtained in a vacuum bulb placed in an alternating electrostatic field. It may be mentioned, however, that the intensity of the effect obtained, or rather the delicacy of the bulb is, to some extent dependent on the quality of glass used, since all glass has a certain screening action, which varies with the different kinds.

The molecular bombardment alluded to by Crookes and Tesla is an effect taking place on disruption in any dielectric probably.

This kind of discharge, which is in reality very common, may be seen between the plates of any influence machine at those parts where the condenser action takes places when the machine is in full work, and forms one of the limiting factors to its output. The discharge in bulbs with one electrode and leading wire, is also explainable in the same way; but there is one condition of discharge, with one electrode and one dielectric, which is not properly understood, and will bear a fuller explanation than has hitherto been given. This is that kind of discharge which takes place from points or other projections when raised to a sufficiently high potential. It can be obtained as a glow discharge in any fluid or gaseous dielectric, and is the effect of a non-uniform field, which breaks down in the strong parts, but not in the weak parts. An electrified conductor, with a pointed projection, has a very strong field immediately around the point, causing the lines of strain to collapse for a short distance outwards, until a weaker field is reached. This collapse places the terminations of the lines at different points in the dielectric itself; in other words, it electrifies the dielectric—not as Faraday supposed, however, namely, by the inherent conductivity of the dielectric, but in the same way as has been explained above, in which the surface of glass becomes electrified when surrounded by a weaker dielectric. The liquid or gaseous dielectric so electrified, however, is free to respond to the effect of the strain, and is forcibly drawn away from the point in the direction of the lines, causing currents or winds. So forcible is this action in oils, that with a sufficiently high potential difference, a fine stream of oil may be made to issue to a considerable height from a vertical point placed in oil, just below the surface. Currents are also set up in oils by a discharging point in the air, above the surface, and in this case there is a marked difference between the behaviour when the field is continuous or alternating. An alternating field, as in the experiment shown by Swinburne, repels the surface of the oil, whereas a continuous or steady field attracts it. The attraction is due to greater specific inductive capacity, the repulsion to the electrification of the surface of the oil, which does not move, on account of the rapidity of reversal.

Prof. Elihu Thomson's experiment of producing what he calls an "induced discharge" of high tension over the surface of oil, in which is immersed a high tension transformer, is, of course, simply a case of collapse of strain in the weak air dielectric.

(To be continued.)

NEW METHOD OF OBTAINING TRACTION OF HEAVY GRADIENTS.

A somewhat novel arrangement, which was originally designed specially for electric railways, so as to permit trains to ascend and descend steep gradients, but which is equally applicable to steam lines, is described and illustrated in the New York *Engineering News*, of September 8th. The device consists in laying in the centre of the track a friction rail which is securely spiked down. The traction wheels to which the power is applied are horizontal, and are mounted on one end of arms, the other ends of which are pivoted to the body of the car. These wheels are kept against the central rail by means of a light spring which gives them a sufficient grip on the rail to prevent slipping at the start and enables them to exert a tractive force upon the car. When this tractive force comes into action, the pressure of the wheels on the rails is increased to, it is said, a point where slipping is impossible. Considerable difficulty was experienced in the designing of a truck and motor to be operated on this principle. In the first car constructed the motor was mounted on the rear axle and actuated bevel gearing by a chain and sprocket wheel connection which meshed with bevel gearing on the faces of the traction wheels. Tests were conducted with this car on gradients of 5 per cent., 15 per cent., and as much as 30 per cent. These were made in the presence of many tramway engineers, and the car was caused to ascend these gradients and stop at any point, whilst it was shown to be under perfect control in descending these gradients. Our contemporary gives an illustration showing the experimental car in a stationary position on the 30 per cent. gradient.

A new car is now being built in which the chains are dispensed with. In this case the motor is mounted with its shaft lengthwise on the car, and by moving a clutch it may be caused to drive either the rear axle by bevel gearing or a chain of gearing connected with the traction wheels. It is believed that this method of traction may also be applicable to steam cars for use on heavy gradients or on elevated railways, where the weight of the motor necessary to haul long trains by the present system is a serious objection. The *Engineering News* thinks that with this method, which has been designed by Mr. H. L. Van Zile, of Albany, N.Y., gradients in one direction only can be mounted or descended. However, by the use of two pairs of traction wheels inclined in opposite directions, or by having the arms upon which a single pair is mounted, arranged to revolve and incline in the opposite direction, this difficulty might be overcome.

It is considered that this grip system would also compete strongly with the rack rail method for mountain railways.

ON AN APPARENT RELATION OF ELECTROMOTIVE FORCE TO GRAVITY.*

By Dr. G. Gore, F.R.S.

In a research on "A General Relation of Electromotive Force to Equivalent Volume and Molecular Velocity of Substances" (*Proc. Birm. Phil. Soc.*, 1892, Vol. viii., pp. 63—138; Electrical Review, Vol. xxx., pp. 693, 722, 755, 786), I have demonstrated by means of a large number and variety of experimental measurements, that the *dilution* of the liquid of a voltaic cell by means of water or alcohol, the *solution* of either the positive metal or the negative one by means of mercury, the *dilution* of either of these amalgams by means of mercury, or the *dilution* of one solid metal by means of another in an alloy, is universally attended by an *increase* of *mean* electromotive force of the diluted and diluting substances beyond the calculated amount, and therefore of the *actual* electromotive force of the diluted one (that of the diluent being very little affected), provided that no chemical union of the diluted and diluting substances occurs. If, however, chemical union does occur, this gain of electromotive force is diminished, or converted into a loss which is larger in proportion as the union is more intimate.

In these experiments, by the act of solution or dilution, the molecules of the active or diluted substance are separated farther apart by those of the neutral or diluting one, and acquire greater freedom of motion, whilst those of the diluent approach only slightly nearer together and do not perceptibly affect the result.

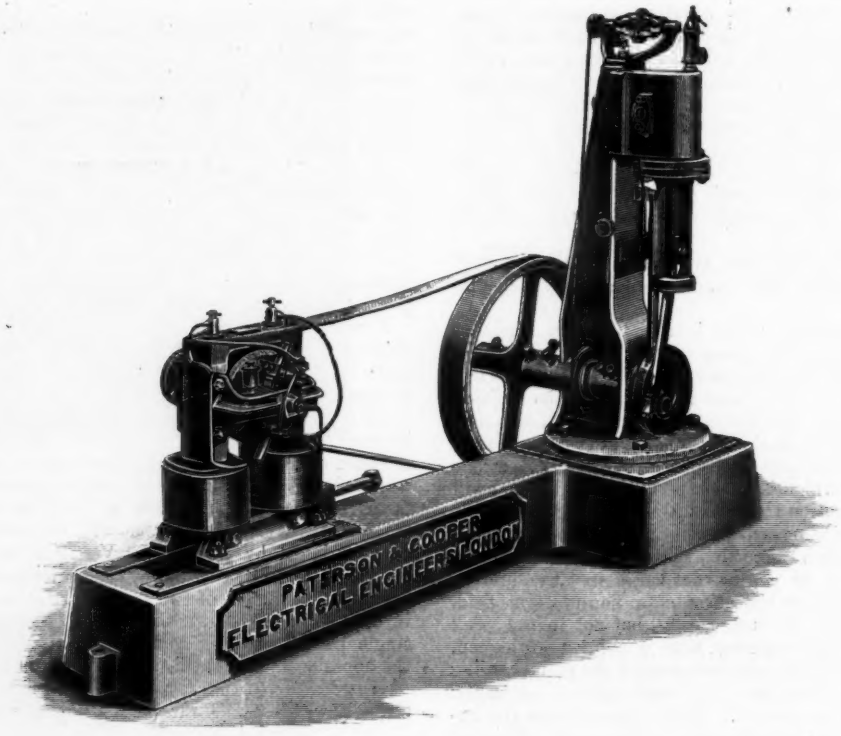
It is generally admitted that the particles of all bodies are in an incessant state of motion, that this motion is the *vis viva* or energy contained in the substance, and that the laws of motion apply equally to the smallest as to the largest

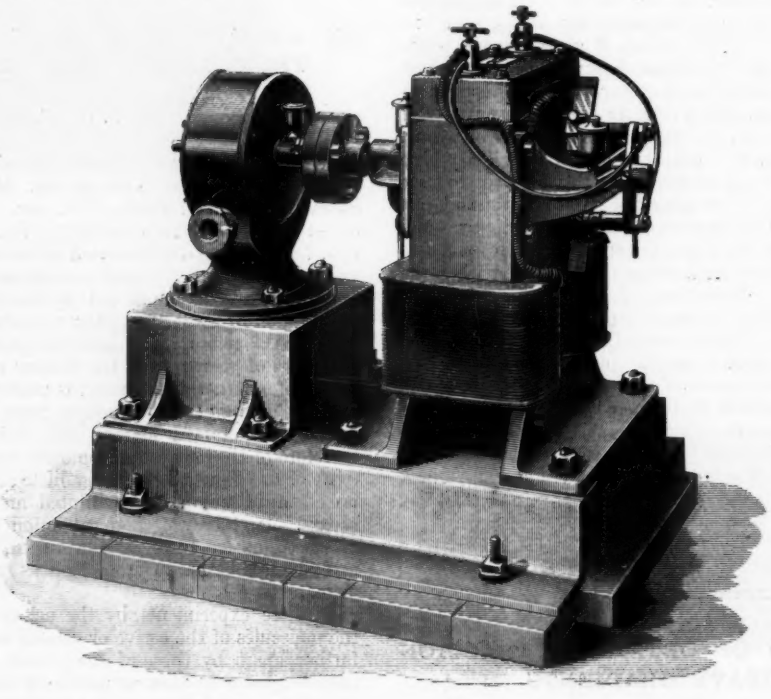
* From the *Philosophical Magazine*.

bodies. If now we regard each molecule of the active substance as vibrating like a pendulum, its movements must obey the law of falling bodies, and the larger the degree of freedom of motion the greater the arc of vibration, the larger the fall, and the greater the velocity of motion. And as in the above-mentioned experiments the volta electromotive force of substances generally has been proved to vary directly as the degree of molecular freedom, it must also, according to this view, be directly related to, and dependent upon, the velocity of molecular motion and the law of gravity in the above manner.

SMALL ELECTRICAL PLANTS.

We herewith give illustrations of two small electrical plants recently constructed by Messrs. Paterson & Cooper, of Dalston. The first engraving shows a small plant for experimental electrolytic work, consisting of a Phœnix No. 00





dynamo, giving an output of 25 ampères and 45 volts at a speed of 600 revolutions per minute. It is mounted on a bedplate which also carries the engine, having planed slides and screw for taking up the belt. The bearings are fitted with syphon lubricators, drain pipes and reservoirs for waste

oil. The engine is of very compact design with cylinder 3½ inches diameter and 5½ inches stroke, driving the dynamo by means of a belt off the fly-wheel. The arrangement being very compact and self-contained, practically no foundation is required.

The second illustration shows a small dynamo, Phœnix No. 0, for charging a set of accumulators, having an output of 24 ampères at 70 volts at 2,500 revolutions per minute, driven direct by a Pelton water-wheel mounted on same bedplate, the whole having been specially designed with a view to extreme lightness. Although small, both these plants are well finished, and quite keep up Messrs. Paterson and Cooper's reputation for good work.

THE USE OF WATER-POWER IN ELECTRIC MINING WORK.

Mr. Irving Hale in the *Engineering Magazine*, New York, refers at length to the use of electricity in mining operations, and lays especial stress on the advantages of water-power where fuel is costly. The question is often asked, "How far does it pay to transmit water-power by electricity?" The answer, of course, depends on circumstances; on the cost of water-power, price of fuel, amount of power and number of hours per day during which it can be used, &c. These items will all affect the pecuniary success of the scheme quite as much as the distance through which the power has to be transmitted. And it is evident that although it is impossible to give a general answer to the question, yet there are many cases where the utilisation of waste water-power will return a handsome dividend on the capital expended.

In Colorado the local circumstances are generally in favour of electricity. Fuel is dear and steam engines are costly. It is not surprising, then, to find that in one of the numerous mines of the district the American pioneer plant for transmitting water-power electrically has been installed. The very necessity of the case made the venture almost a certainty from the moment a reliable motor was in the market. In 1888 a Sprague electric hoist was erected and is giving satisfactory results to-day. At this "camp" called Aspen, there are now five electric winding engines, three electric diamond drills, three electrically driven fans, a 20 H.P. and several smaller motors for running other machinery; and it is needless to say that the electric light is also largely used. The water is brought down a wrought-iron pipe, 4,500 feet long. The head is 876 feet and the H.P. about 350.

The quantity of water is relatively small, and in the tail race gives no indication of the power expended in the Pelton wheels. "If the covers be raised and an attempt be made to pinch the little jets between the finger and thumb, the energy is at once apparent. The spray on the surface of the jet presents a velvety feeling to the touch; but when the fingers have sunk about a 16th of an inch into the water, it is as hard and impenetrable as if it were frozen, and it is said to be impossible to cut the jet with an axe."

The Virginius mine, near Ouray, Colorado, has also a remarkable electrical plant driven by water-power. The camp is 12,700 feet above the sea level in the region of perpetual snow, and coal is worth $20 per ton. The installation is similar in the essential details to that at Aspen; and the total horse-power is about 250. It is no wonder that considerable difficulties were at first met with in erecting the line, but these have all been successfully overcome.

Mr. Hale says "that there are hundreds of mines in Colorado using steam-power to-day which are within reach of good water-power, and in many cases an electric installation would cause a saving that would pay from 40 to 100 per cent. per annum on the investment. It is not a wild prophecy to say that within the next three years scores of such plants, developing thousands of horse-power, will be installed."

"Next to the silver question, the introduction of electric power is at present the most important factor affecting the future of the mining industry in Colorado; and, unlike free coinage, electric power is not dependent on legislative action, but is entirely under the control of the mining men themselves."

We may expect a boom in electric mining machinery if Mr. Hale be correct in his surmises.

NOTES.

Portraiture.—The *India-Rubber World* for September contains a biography and full page portrait of the late Mr. Austin Goodyear Day. Mr. Day, says our contemporary, made 3,000 experiments, and accidentally discovered that which made him famous—kerite. He found at first his ideas, as represented in it, rather crude, but he gradually built it up from the starting point. At that time the telegraph companies were using wires insulated in an inferior manner, for which the demand was not large. This was in 1867. Telegraph officials soon became attached, however, to kerite, and used it. Mr. Day also studied submarine cable engineering. His death took place in 1890.

Cooking by Electricity.—A few days ago we sent Mr. H. J. Dowsing a copy of a menu, which appeared in the New York *Electrical Review*, of a dinner cooked by electricity. In reply, he has written to us stating that it is not at all a new experience for Messrs. Crompton & Co. to turn out a dinner in this way, as they did so nightly at the Horticultural Exhibition for some time. At the Crystal Palace they cooked a large proportion of the dinner, but, of course, had not then all the appliances necessary for baking, &c. They have made a most successful electric cooking stove on the principle of gas stoves, and it bakes perfectly. The tests, so far, lead them to anticipate most excellent results, and at not too great a cost for the stove to come into public use. Messrs. Crompton hope shortly to have some of their newly designed stoves ready for use, and they will then make public all particulars concerning the current used, and the success with which the apparatus can be employed.

Incandescent Lamps of High E.M.F.—Attention is now being drawn in America to the manufacture of lamps of high voltage, *i.e.*, from 150 volts to 300 volts, and in the *Electrical Engineer* (New York), for September 14th, Mr. H. E. Vineing makes some suggestive remarks on the subject. There are certainly some appreciable advantages to be gained in using lamps of this description, the principal being the smaller sized mains necessary, decreased blackening of the bulbs, and diminished variation in the light emitted through unavoidable alteration in pressure in the mains supplying the current. But the manufacturer of such lamps experiences a number of difficulties which go far to counterbalance the advantages. To obtain the requisite resistance the filament has to be very considerably lengthened, and this necessitates its being supported in the middle, for lamps of say 16 C.P., to prevent excessive vibration; further the breakage of filaments in each stage of lamp manufacture, increases enormously as the section is diminished, thus causing considerable loss of labour. Moreover, that curious phenomenon known as "arcing," becomes no unfamiliar incident when running lamps of high E.M.F. on the pumps, and thus a further number of almost completed lamps are rendered useless. But apart from difficulties of manufacture there must be considered the well established fact that the life of such lamps at a given efficiency compare very unfavourably with lamps containing stouter filaments. These difficulties and objections must therefore materially enhance the annual sum expended in lamps of this description, and it becomes a question whether the advantages in their favour are sufficient to render their manufacture desirable. Naturally if the difficulties of manufacture are gradually reduced to a minimum by experiment and experience, the case would be altered, and Mr. Vineing claims to have taken an important step in this direction by treating bamboo fibres by a certain chemical process, whereby the resistance of the carbon is so raised as to render filaments of customary lengths suitable for 16 C.P. lamps of 150 to 280 volts. The cost of the treatment for effecting the change in resistance is said to be $1 per 1,000 fibres, and the lamps are stated to have an average life of 500 hours at 3·6 watts per candle-power. The conclusion at which Mr. Vineing arrives is that those grappling with the problem will find the solution in the treatment of the filament rather than in mechanical devices, and in this view we fully agree. In Europe, however, we have not the same respect for filaments of bamboo fibre, as some parties possess in America. We may mention that we are familiar with excellent lamps in this quarter of the globe of 110 volts 5 C.P. at 3·5 to 4 watts, or equivalent to 220 volts 10 C.P.

St. Thomas' Charterhouse Schools.—For the sixth time, a pupil (B. T. Squibb) of these schools has just been declared a winner of one of the Sadler's Scholarships (value £60); the other being taken by H. C. Ashton, of the Central Foundation Schools. W. Childs, of the St. Thomas Charter house School, succeeded in obtaining one of the two (No. 5) Free Studentships (value £30), of the Technical College, Finsbury. T. Godwin, of the Alleyne's School, Dulwich, carried off the other. Five pupils of the St. Thomas' School passed the entrance examination of the College. Thus, so far, no pupil has failed to pass the City and Guilds of London Institute.

Registered to Kill or Cure.—In an address at University College on Monday last, Mr. S. J. Hutchinson, in his recommendations to the students, made the following remarks: "The State insists upon the medical student undergoing a five years' curriculum of severe study in all sorts of subjects; it compels him to pass difficult examinations; and then, when he had done everything, and satisfied everybody, and got his degree or diploma, what did the State do for him? Did it protect him in any way against the bone-setter, the herbalist, the medical electrician, the mesmerist, the midwife, or the prescribing chemist, or the legion of American and other foreign gentlemen with a might-be bogus degree? He thought the day was not far distant when it would be impossible for any of these gentry to practise any form of the healing art unless they were entitled to be registered." Seriously, we hope that day will soon come.

Gramme Armatures in Station Generators.—An article on this subject recently appeared in the New York *Electrical Engineer*, from the pen of Mr. L. E. Marple, in which the writer set forth the important advantages in the Gramme ring type of armatures over others. He refers to cases in which drum armatures were in use, where the armatures burnt out while being started, even before the normal E.M.F. had been reached. Mr. Marple ends his article thus:—"It would doubtless be of value to learn from various comparisons of the two forms of armatures under like conditions, what is the actual average difference in length of life."

The following letters have since been published in our contemporary's columns:—

Letter from the Superintendent of the factory of the Brush Electric Company:—"This article bears out fully the operation of Gramme ring armatures, such as have been used by the Brush Company ever since its existence. As this company has never made any other kind of armature, the results obtained by them with the Gramme armature show conclusively that it is only because the armature can be and is so thoroughly ventilated as to produce a long life in the bobbins of armatures. There are hundreds of armatures in daily use of this type which were made 10 years ago, and are still running with the same winding on them. I know of no other type of armature which can show such a record as this. All generators manufactured by this company also have this form of an armature. The bobbins on same have very few layers of wire, and are, therefore, easily repaired should an accident occur. The fact of there being very little wire on the armatures per bobbin also permits quick radiation of heat, and the life of the insulation is greatly prolonged thereby."

Letter from Mr. H. F. Parshall, of the Thomson-Houston Electric Company's factory at Lynn:—"The remarks of Mr. Marple do not apply to the style of drum winding at present used by this company. The drum armatures with the bifurcated end conductors are more easily ventilated, easier to repair, and less liable to give trouble than the Gramme type of armature. The use of the bifurcated end conductor makes it possible to replace any particular bar without disturbing any other. It also leaves these conductors thoroughly ventilated on both sides, since there is a good-sized air duct between the end conductors and the core of the armature. The core of the armature is ventilated by means of several ducts arranged in planes perpendicular to the axis of the armature. By experiment it has been found that the ventilating capacity of an armature of this construction has been doubled over that of the ordinary Gramme construction. I should say, therefore, that qualifying terms should be used in this article to distinguish between the new and old types of drum winding."

Glasgow Electric Lighting.—It is stated that the Glasgow Electric Lighting Committee expect to be in a position to begin supplying the new light to private consumers not later than December 1st. It is further expected that the illumination of the principal streets in the central district of the city will be accomplished before the close of this year.

The Franklin Institute.—An advance proof received from the Franklin Institute, Philadelphia, announces the following papers to be read during the 1892-93 session:—Monday, December 12th, 1892, Mr. T. Commerford Martin, Editor *Electrical Engineer*, New York, "Electricity in the Modern City" (illustrated). Monday, December 19th, 1892, Mr. George Faunce, Superintendent Pennsylvania Lead Company, Pittsburg, Pa., "Electro-Metallurgy and its Applications to Silver Refining and Incidentally to other Metals." Monday, January 2nd, 1893, Mr. Pedro G. Salom, Philadelphia, "The Storage Battery Question." Monday, January 9th, 1893, Mr. Emile Berliner, Washington, D.C., "Technical Notes on the Gramophone, with illustrations." Monday, January 23rd, 1893, Dr. Louis Duncan, Johns Hopkins University, Baltimore, Md., "Electric Power Transmission." Monday, January 6th, 1893, Mr. Elmer G. Willyoung, with Queen & Co., Philadelphia, "Electricity and the Ether" (illustrated). Friday, January 24th, 1893, Mr. Nikola Tesla, New York, "An Experimental Study of Light Effects produced by Alternating High Potentials" (illustrated). Monday, January 27th, "Mr. Clayton W. Pike, with Queen & Co., Philadelphia, "How we Measure Electricity" (illustrated).

New Scientific Books.—Under this heading *Nature* gives this information:—Among Messrs. Macmillan and Company's announcements are the following books: "Researches on the Propagation of Electrical Force," by Prof. Henrich Hertz, authorised translation by Prof. D. E. Jones, B.Sc., illustrated; "Electrical Papers," by Oliver Heaviside; "Pioneers of Science," by Prof. Oliver Lodge, with portraits and other illustrations; "The Theory and Practice of Absolute Measurements in Electricity and Magnetism," by Prof. A. Gray, Vol. II. Among the books in active preparation at the Clarendon Press may be mentioned:—A supplementary volume to Prof. Clerk Maxwell's "Treatise on Electricity and Magnetism," by J. J. Thomson. Messrs. Whittaker & Co. announce: Prof. Oliver Lodge's "Treatise on Lightning Conductors and Lightning Guards;" "A Comprehensive Work on the Dynamo," by C. C. Hawkins and F. Wallis; "Electrical Experiments," by G. E. Bonney; "Practical Electric Light Fitting," by F. C. Allsop; "Electric Lighting and Power Distribution," by W. Perren Maycock, M.I.E.E.; "How to Manage a Dynamo," by S. R. Bottone. In the Library of Popular Science: "Electricity and Magnetism," by S. R. Bottone; "Chemistry," by T. Bolas, F.I.E., F.C.S. Messrs. Baillière, Tindall and Cox have in the press: "A Manual of Practical Medical Electricity," by Dawson Turner, M.D., F.R.C.P., Ed., M.R.C.P. Lond. Messrs. Sampson Low & Co., Limited, have in hand: "The Student's Chemistry," by R. L. Taylor, F.I.C., F.C.S., fully illustrated. Messrs. Cassell & Co., Limited, announce: "The Year-Book of Science" (second year of issue), edited by Prof. Bonney, F.R.S., and containing contributions by leading scientific writers. Messrs. Chas. Griffin & Co., Limited, will issue: "Applied Mechanics" (an Elementary Manual of), for first year students, by Prof. A. Jamieson, F.R.S.E., with very numerous illustrations; and "Griffin's Electrical Price-Book," for the use of electrical, civil, marine, and borough engineers, local authorities, architects, railway contractors, &c., edited by H. J. Dowsing. Messrs. Longmans & Co. are preparing for publication: An English translation of Wüllner's "Lehrbuch der Electricität," in 2 vols., translated and edited by G. W. de Tunzelmann, B.Sc., with 310 illustrations. The English editor has added much new matter, and by some changes of arrangement and mode of presenting the subject has endeavoured to make it a truthful representation of the present state of electrical science. "Chemical Lecture Experiments," by G. S. Newth. Messrs. Lawrence and Bullen will publish: "Matriculation Chemistry," by Temple Orme. Messrs. J. and A. Churchill promise "Electric Lighting," by Prof. Garnett.

Middlesbrough and Electric Lighting.—The Middlesbrough Corporation have decided to apply for a provisional order next year.

Accrington and the Electric Light.—The Accrington Town Council last week sanctioned a scheme for purchasing land for and erecting, at a cost of under £10,000, an electric lighting station to supply the town with the electric light.

Failure of the Electric Light in Dublin.—We hear that on Tuesday night the principal thoroughfares in Dublin were thrown into temporary darkness by the partial failure of the electric light. The lamps became suddenly low, and many of them went out altogether. The occurrence was due to the falling off of steam pressure at the central station.

Electric Lighting at Blackpool.—According to the *Manchester Courier*, a statement was made at the Blackpool Town Council last Tuesday, to the effect that the arrangements for the installation of the town with the electric light are near completion. A tender of £18,709 for the whole of the plant was accepted by the council, who intend to use the same dynamos for running the electric trams during the day, and generating current at night for the illumination of the town.

Electric Lighting for Hawick.—At a meeting of Hawick Town Council on Tuesday, an elaborate report was submitted from Messrs. Mavor & Coulson, electrical engineers, Glasgow, who made a series of experiments last season with a view to having Hawick lighted by electricity. It was stated that the cost of lighting the burgh by electricity would be £820, while the estimated outlay with gas for the current year was £841. Several members commented on the fact that the price of gas had recently been increased by 7½d. per 1,000 cubic feet. A committee was formed to report on the matter after consideration.

Measuring the Velocity of the Current.—"A Fellow of the Royal Astronomical Society" writes to the *English Mechanic* as follows, in reply to a question asked in our contemporary's columns by another correspondent:—"If there were an observer furnished with a clock and a transit instrument at each end of the Atlantic cable, the velocity of the current might be measured with the greatest accuracy. For, call the English station E, and the American one W; and suppose that the man at E strikes the key of his instrument, and notes the time by his clock, then, as the armature of the magnet at W will move practically simultaneously, making a very audible click, the observer there notes the instant by his clock when he hears the sound, and the difference of the two times, supposing the clocks to be set right to local time, is at once the difference between the two clocks and the longitude. Now, if the electric current took *no* time to traverse the cable, then the apparent difference between the two clocks would be identical, whether it was determined by signalling from east to west or from west to east. But if it does occupy an appreciable interval, the results would differ. To simplify matters, suppose that the difference of longitude is only one hour, and that the current occupies exactly one second in travelling between the two stations. If, then, at noon a signal is made at E, it will be 11h. 0m. 1s. a.m. when it is heard at W—*i.e.*, the apparent difference of the two clocks will be 59m. 59s. If, though, we make a signal at W at noon, then it will be heard at E at 1h. 1m. p.m., or the apparent difference between the clocks will be 1 hour and 1 second. Hence the clocks will seem to differ by *twice* the time required for a signal to travel from E to W; the 2 seconds discrepancy in the results being double the time that the signal takes to pass over the wire."

The South American Cable.—The ss. *Silvertown* arrived in London on Tuesday last, after completing the laying of the South American cable. Everything is satisfactory.

NEW COMPANIES REGISTERED.

The Electro-Alkali Company, Limited.—Capital, £160,000 in £10 shares. Objects: To enter into and carry into effect, either with or without modification, an agreement to be made between the Electric Construction Corporation, Limited, of the one part, and this company of the other part, providing for the acquisition by the company of the patent or patent rights, and license in the said agreement referred to, or to purchase or acquire such patents and rights, or any of them, upon other terms; to purchase or otherwise acquire any other inventions in relation to any chemical, electrolytical, or electro-chemical process, or to any apparatus, implements, or machinery for, or in connection with electricity or any such process or manufacture, or of which the acquisition or use may be deemed in any way desirable or likely to benefit the company, and generally to develop, improve, bring into public use, and work any such inventions as aforesaid. Signatories (with one share each): W. Young, 109, Crofton Road, Peckham Road, S.E., gentleman; F. J. Allen, 14, Trelawn Road, Brixton, S.W., gentleman; F. Virgo, 93, Earl's Court Road, S.W., gentleman; W. H. McCarthy, 101, Brook Street, Kennington, S.E., accountant; J. Payne, 5, Richmond Terrace, Clapham Road, S.W., secretary to a public company; J. R. Threadgold, 19, Shenley Road, Camberwell, S.E., shorthand writer; S. T. Bishop, 6A, York Grove, Peckham, S.E., gentleman. The number of directors (including the managing director) is not to be less than three nor more than seven, the first being nominated by the signatories to the memorandum and articles of association, or the majority of them, in writing. Qualification: £100. Remuneration: For each financial year, in any event, an amount equal to £100 for each director, and for each financial year a sum equal to £10 per cent. on the gross profits of that year, and in the event of any sales under section 3, sub-section 7, of the memorandum, a sum equal to £10 per cent. on the amount realised by such sales. Registered on the 20th ult., by Bonner, Wright, Thompson & Co., 165, Fenchurch Street, E.C., solicitors.

The London Health Electrical Institute, Limited.—Capital £10,000 in £1 shares. Objects: To adopt and carry into effect an agreement made September 16th, 1892, between G. J. Spalding and M. C. Spalding of the one part, and T. J. Hartshorn (for the company) of the other part for the acquisition of the business now carried on under the style of "The Magneto-Electric Battery Company," and the London Health Electrical Institute or "The Health Electrical Institution," of London; to provide for the treatment of diseases by means of appliances employing electricity, as manufacturers of and dealers in medical and surgical instruments; the promotion of companies and the general business of a financial agency, to acquire patents, patent rights, &c., and to develop and work the same. Signatories (with one share each), G. J. Spalding, Imperial Mansions, Oxford Street, W., Electrician; M. C. Spalding (same address) electrician; R. L. Hawkins, 13, May Grove Road, Brondesbury, N.W., chemist; W. J. Kelly, 3, Mall Road, Hammersmith, W., advertising clerk; H. M Spalding, 17, Hillmarton Road, N.; T. J. Hartshorn, 29, Grove Terrace, Highgate Road, N.W., solicitor's clerk; W. Johnson, jun., 14, Devonshire Square, Bishopsgate, E.C., wine merchant. The first directors are G. J. Spalding and M. C. Spalding. Qualification £2,000. Remuneration £600 and £300 per annum respectively. Registered by Mann and Taylor, 109, New Oxford Street, W. Registered offices, Imperial Mansions, Oxford Street, W., and 178, Charing Cross Road, W.C.

The Carbon Battery Company, Limited.—Capital, £10,000 in £1 shares. Objects: To manufacture, sell, and deal in electricity, and the by-products arising from the manufacture thereof, and to manufacture, sell, and deal in aluminium, and other metals alloyed with aluminium, and magnesium and other metals, and in chemical and other substances arising out of the manufacture, or otherwise, in the United Kingdom and in the Eastern hemisphere; to purchase, or otherwise acquire, letters patent for an improved process for the manufacture of electricity from carbon, the recovery and purification of the by-products arising therefrom, and apparatus therefor, &c. Signatories (with 5 shares each): S. Wellington, 28A, Basinghall Street, E.C.; F. A. Freeland, 11, Richmond Road, Barnsbury, N.; C. E. Jolley,

29, St. George's Road, N.W.; H. Russell, 74, Chancery Lane, W.C.; L. Herg, 49, Grosvenor Road, Highbury New Park; C. H. Russell, 34, Chapter Road, N.W.; J. T. Shrives, 337, High Holborn. Registered on the 28th ult., without special articles of association, by Mr. H. C. Bull, 29, St. George's Road, N.W.

New Electrical Metallurgical Syndicate, Limited.—Capital £10,000 in £1 shares. Objects:—To acquire certain patents relating to the production of metals by electrolysis, and the recovery and purification of the by-products arising therefrom, and apparatus therefor. Signatories (with five shares each): F. A. Freeland, 11, Richmond Road, Barnsbury, N.; S. Wellington, 28A, Basinghall Street, E.C.; H. Russell, 74, Chancery Lane, W.C.; C. E. Jolley, 29, St. George's Road, N.W.; L. Herg, 49, Grosvenor Road, Highbury New Park; C. H. Russell, 34, Chapter Road, N.W.; J. T. Shrives, 337, High Holborn, W.C. Registered on the 20th ult., without special articles of association, by Mr. H. C. Bull, 29, St. George's Road, N.W.

New Sulphur Recovery Syndicate, Limited.—Capital £10,000, in £1 shares. Objects: To acquire certain patents and inventions relating to an improved process for the recovery of sulphur, and the recovery and purification of the by-products arising therefrom, and apparatus therefor, and as dealers in aluminium, magnesium, &c. Signatories (with 5 shares each): F. A. Freeland, 11, Richmond Road, Barnsbury; S. Wellington, 28A, Basinghall Street, E.C.; C. E. Jolley, 39, St. George's Road, N.W.; H. Russell, 74, Chancery Lane, W.C.; L. Herg, 49, Grosvenor Road, Highbury New Park; C. H. Russell, 34, Chapter Road, N.W.; J. T. Shrives, 337, High Holborn. Registered on the 28th ult., without special articles of association, by Mr. H. C. Bull, 29, St. George's Road, N.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Reading Electric Light Company, Limited. — The statutory return of this company, made up to June 2nd, has been filed. The nominal capital of the company is £75,000, in £5 shares, seven of these shares having been taken up. No calls have been made, and nothing paid. The original signatories are the only shareholders.

Sheffield Telephone Exchange and Electric Light Company, Limited.—The annual return of this company, made up to the 1st ult., was filed on the 29th ult. The nominal capital is £100,000 in £10 shares; 4,000 ordinary and 1,162 preference shares have been taken up, and £10 has been called up on each of the preference shares, and £8 considered as called on each of the ordinary shares. The calls paid and agreed to be considered as paid, amount to £43,440, and unpaid to £180.

At an extraordinary general meeting of the company, convened and held at the Cutlers' Hall, Church Street, Sheffield, on July 18th last, the following special resolutions were duly passed, and at a subsequent meeting, held at the same place on the 2nd ult., were duly confirmed, namely:—

1. That it was expedient to reconstruct the company, and, accordingly, that the company should be wound up voluntarily, and that Thomas George Shuttleworth, of Sheffield, chartered accountant, and William Johnson, of Sheffield, the secretary of the company, should be appointed liquidators, for the purposes of such winding up.

2. That the agreement, dated May 5th, 1892, and made between the company of the one part, and The Sheffield Electric Light and Power Company, Limited, of the other part, submitted to the meeting, should be approved, and the liquidators authorised, pursuant to Section 161 of the Companies Act, 1862, to adopt the said agreement, and carry the same into effect.

The Electrical Standardising, Testing, and Training Institution, Limited.—The annual return of this company, made up to December 31st, 1891, was filed on June 10th last. The nominal capital is £10,000, divided into 1,900 ordinary and 100 founder's shares of £5 each respectively; seven of these have been taken up, but no calls made. Registered office, 15, St. Helen's Place, E.C.

Electric Fittings, Hiring and Maintenance Company, Limited.—The statutory return of this company, made up to February 23rd last, was filed on the 15th ult. The nominal capital is £200,500, divided into 40,000 ordinary shares of £5 each, and 500 founders' shares of £1 each, 7 shares having been taken up, but no calls have been made. The only shareholders are the original signatories to the Memorandum of Association.

Globe Telegraph and Trust Company, Limited.—The annual return of this company, made up to the 9th ult., has been filed. The nominal capital, when the company was registered on July 11th, 1873, was £3,000,000, in £10 shares, but since then the capital has been raised to £5,000,000, divided into 250,000 ordinary and 250,000 preference shares of £10 each. 180,227 ordinary and 180,042 preference shares have been taken up, the full amount called, and all calls paid.

Fowler Insulator Syndicate, Limited.—The annual return of this company, made up to September 23rd, 1891, was filed on May 20th last. The nominal capital is £6,000 divided into 5,500 ordinary and 500 deferred shares of £1 each; 3,042 ordinary and 500 deferred shares have been taken up. Upon each of 2,042 ordinary shares £1 has been called, and with the exception of £7 all calls have been paid. Registered office, 101, Leadenhall Street, E.C.

The Chelsea Electricity Supply Company, Limited.—The annual return of this company, made up to May 26th last, was filed on July 20th. The nominal capital is £100,500 divided into 20,000 shares of £5 each, and 500 shares of £1 each; 9,277 of the former, and the whole of the latter, have been taken up. Upon each of 3,611 shares £5 has been called, and all calls (£18,055) paid. Registered office, 37, Sloane Street, S.W.

California Gas, Water and Electric Light Company Syndicate, Limited.—The statutory return of this company, made up to April 15th, 1892, was filed on the 30th ult. The nominal capital is £2,000, divided into 2,000 shares of £1 each; 1,475 of these have been taken up and the full amount called, and all calls (£1,475) paid. Registered office, 20, Bucklersbury, E.C.

The Exchange Telegraph Company, Limited.—The annual return of this company made up to August 12th last was filed on the 19th. The nominal capital is £246,250 divided into 8,125 A and 16,500 B shares of £10 each, respectively. The whole of the A shares have been taken up, and 16,200 B shares. £9 has been called up on each of 6,000 A shares, and the calls paid amount to £53,898, and unpaid, to £102. Registered office: 66, Haymarket.

The Globe Telegraph and Trust Company, Limited.—The annual return of this company, made up to August 9th last, was filed on the 24th. The nominal capital is £5,000,000 divided into £250,000 preference and 250,000 ordinary shares of £10 each, respectively. 180,042 preference and 180,227 ordinary shares have have been taken up, and the full amount called, and all calls (£3,602,690) paid. Registered office: Winchester House, E.C.

Edison & Swan United Electric Light Company, Limited.—The annual return of this company, made up to August 2nd last, was filed on August 8th. The nominal capital is £1,000,000, divided into 150,000 A shares, and 50,000 B shares of £5 each respectively. 89,261 A £3 paid, 17,139 A fully paid, and 23,564 B shares fully paid have been taken up, and 10s. has been called up on each of 89,261 shares, and all calls (£44,630 10s.) paid. Registered office, 100, Victoria Street, S.W.

United River Plate Telephone Company, Limited.—The annual return of this company, made up to the 9th ult., was filed on the 15th ult. The nominal capital is £500,000 divided into 100,000 shares of £5 each. 58,000 of the shares have been taken up and upon 42,000 £5 has been called and paid, £80,000 being the total amount agreed to be considered as paid on 16,000 of the shares. Registered office, 53, New Broad Street, E.C.

Ateliers Hoster de St. Nicolas, Limited.—The office copy of the winding-up order made by Mr. Justice Vaughan Williams on August 11th last, against the above-named company, was filed by the Registrar of Joint Stock Companies on August 20th.

Easton & Anderson, Limited.—The annual return of this company, made up to May 13th last, was filed on the 21st of the same month. The company was registered on June 4th, 1888, with a capital of £250,000, in £100 shares, being subsequently divided into 2,060 ordinary, and 440 5 per cent. preference shares of £100 each. All the ordinary shares (issued as fully paid) have been taken up, and 184 of the preference shares, upon which the full amounts have been called and paid.

Dalziel's Cable News Agency, Limited.—The annual return of this company, made up to March 1st last, was filed on May 31st. The nominal capital is £1,000 in £5 shares; 200 of these have been taken up, the full amount called, and all calls (£1,000) paid. Registered office, 222, Strand, W.C.

The Exeter Electric Light Company, Limited.—The annual return of this company, made up to August 20th last, was filed on the 23rd of the same month. The nominal capital is £20,000 in £10 shares; 1,008 of these have been taken up, and the full amount called. The calls paid amount to £9,880, and unpaid to £200. Registered office, The Rockfield Works, New North Road, Exeter.

The Anglo-Portuguese Telephone Company, Limited.—The annual return of this company, made up to April 14th last, was filed on the 19th of the same month. The nominal capital is £75,000, in £1 shares; 50,000 of these have been taken up, but nothing called. Registered office, 53, New Broad Street, E.C.

The Brighton and Hove Electric Light Company, Limited.—The annual return of this company, made up to August 23rd last, was filed on the 29th ult. The nominal capital is £100,000, in £5 shares; 3,000 of these have been taken up, the full amount called, and all calls (£15,000) paid. Registered office, Gloucester Road, Brighton.

China and Japan Telephone Company, Limited.—The annual return of this company, made up to June 7th last, was filed on the 13th of the same month. The nominal capital is £20,000 in £1 shares; 14,761 of these have been taken up, but nothing called. Registered office, 14, Austin Friars, E.C.

The Buenos Ayres Electric Light Company, Limited.—The annual return of this company, made up to June 22nd last, was filed on the 19th ult. The nominal capital is £100,000 divided into 9,986 shares of £10 each, and 70 founders' shares of £2 each. All the founders' shares have been taken up, but nothing called. Registered office, 2, East India Avenue.

The Eastern and South African Telegraph Company, Limited.—The annual return of this company, made up to August 5th last, was filed on the 17th of the same month. The nominal capital is £600,000, in £10 shares. All the shares have been taken up, the full amount called, and all calls (£600,000) paid. Registered office, Winchester House, 50, Old Broad Street, E.C.

BUSINESS NOTICES, &c.

The New South American Telegraph Cable.—We understand that the new South American Cable is now open for traffic. The company has opened receiving offices for messages at 106, Cannon Street and 27, Royal Exchange. Messages must be directed viâ Teneriffe.

New Catalogues.—The third edition of their first-class catalogue has just been brought out by Messrs. L. M. Ericsson & Co., of Stockholm. A frontispiece printed in gold, silver, and a number of colours illustrates a set of telephone apparatus. A prefatory note contains the information that the firm has taken measures to increase their producing powers, as well as having reduced their prices. The catalogue is purely a telephonic and telegraphic one, and the different chapters deal with the following branches of the business: Switches, receivers, switchboards, and testing boxes; Morse telegraphic apparatus, testing instruments, fire alarm apparatus, sundry gauges and indicators. Everything that is mentioned in the catalogue is described in both English and in the language of the country. The blocks are very finely cut, the printing is clear and good, and as a whole the catalogue is well got up, and will be useful to those who need a good book on the subject.

The India-Rubber Gutta-Percha and Telegraph Works Company have just brought out a new price list of electric light cables and wires. Seeing that the list is dated October, 1892, only the very latest prices and information are contained therein. Like all former lists of the India-Rubber Company, the present one is of a very complete description. It is divided into two parts—the first relating to vulcanised, and the second to unvulcanised rubber cables. In the first part, for convenience, the various classes have been arranged together according to their insulation resistances. For further reference there has been attached to the price list, tables giving full particulars of conductor resistance, area, and weight of the standard size conductors.

The Electric Light in the City.—The adoption of the electric light in the City shows as yet no falling off. Since our last report we notice that Messrs. Sharp & Kent are fitting up some new premises in Wormwood Street, E.C.—Messrs. Laing, Wharton and Down are engaged in fitting up the premises of Messrs. Brightwen and Co., Finch Lane, E.C., and also in St. George's House, Eastcheap.—Mr. J. Torr Lodman is fitting up the new premises of the Metropolitan, Birmingham, and South Wales Bank, Limited, Gracechurch Street, while Messrs. J. Defries & Sons are at work at 9, Fenchurch Street.—Fitting work is being carried out in the Wine Bar, Finch Lane.—Messrs. Rashleigh Phipps & Dawson are fitting up Rochester Buildings, 138, Leadenhall Street.—Messrs. J. Defries & Son are engaged on work at the Hercules Tavern, Leadenhall Street.—Fittings are being put in the premises of Messrs. Loewenstark and Son, jewellers, 32, Aldgate.—The Brush Electrical Engineering Company are fitting up 58, Lombard Street, while the Electrical Supplies and Fittings Company, of Charing Cross Road, W.C., are engaged on work at the Royal Insurance Buildings, also in Lombard Street.—Messrs. Laing, Wharton & Down, of New Bond Street, W., are fitting up the premises of Messrs. Rice Brothers, St. Swithin's Lane.—Messrs. Fuller & Tate, of Bucklersbury, have recently completed the premises of Messrs. Sharp & Snowdon, tobacconists, 10, Cheapside, in which a somewhat novel arrangement of external window illumination has been adopted.—The new premises of Messrs. Deverell Bros., 9, Cheapside, are being fitted up by Messrs. Rashleigh Phipps & Dawson, of Berners Street, W.

Marking an Epoch in the Central Station Industry.—Whether competition in electrical matters is beneficial or not, it is indisputable that in catalogue compilation it results in some really splendid books being brought out now-a-days. The commonplace word catalogue is not sufficiently descriptive of an exceptionally well got-up publication just issued by Messrs. J. E. H. Gordon and Co., Limited. The subject particularly dealt with is the contracts which have been carried out, and the work at present being executed by Messrs. Gordon. Precursory to the descriptions of a number of central stations, there is given on a page 18 inches by 12½ inches, a very true and well printed portrait of Mr. J. E. H. Gordon, B.A., M.I.C.E., M.I.E.E., who is chairman of the company. Following this photo there is a note of the works completed or in hand, thus:—

	Capacity in 10 C.P. lamps.
c Paddington, Great Western Railway	30,000
c Manchester Square, London	50,000
c Rathbone Place, London	25,000
c Whitehall Court, London	10,000
c Crystal Palace and Sydenham District	20,000
c Carlow, Ireland	2,000
c Larne, Ireland	4,000
c Bray, Ireland	10,000
c Coatbridge, Scotland	9,000
	160,000

c as engineers. *c* as contractors.

These works have cost over £500,000 sterling. A note is next given setting forth the objects in the formation of the company, *i.e.*, designing and carrying out complete central stations and systems of mains at fixed inclusive prices stated beforehand. Messrs. Gordon are not manufacturers, but merely purchasers of the machinery they consider best suited to the requirements of any particular town. Then follows a brief history of the progress of the company. Space will not allow us to go very fully into the descriptions so carefully prepared of the stations, but we will give a note of the different headings and illustrations. Paddington (Great Western Railway Company) central station is illustrated by four full page drawings of the engine and dynamo room, end view; the same, front view; boiler room; and Paddington by night, from a photograph of the goods station taken at 9 p.m. on a November night; also a number of smaller illustrations. Whitehall Avenue central station is described. Manchester Square station is very fully shown by full page photos of the boiler house; engine room; switchboard; exciters. Rathbone Place station is described, as is also Carlow station. The photos taken to illustrate the latter are:—Lamp post in Carlow, showing transformer and overhead wires; exterior of the electric light station at Milford, which lights the town of Carlow, five miles distant; interior of the same station. Larne station is similarly shown by illustrations of the exterior; boiler house; and two photos of the engine room. Bray central station is also described by two views of the engine room; lamp post in esplanade; the engines; dynamo and exciter; boiler house; two full page blocks of architectural details; one of details of chimney; one giving plan and elevation of boilers, engines, and dynamos; one showing details of exhaust pipes and water heaters; plan of the station; elevation view of the station. Messrs. Gordon announce on the last page that as they are going to press with the volume, they have received orders for a £20,000 plant for Coatbridge, and for a small plant for Windsor. The quality of the paper and printing in this book, and the careful preparation of the matter, indicate that no expense has been spared to ensure a first class publication. There is little doubt that the present venture of Messrs. Gordon marks an epoch in the development of electric lighting, and proves that the electro-technical industry can hardly any longer be considered to be in an embryo state, when contractors are able to publish such a catalogue of works, and to supply them to order as a matter of ordinary business routine.

Electric Lighting at Exeter.—At a meeting of the Exeter Town Council last week, the Parliamentary Committee reported the receipt of applications from Mr. J. H. Stanbury and Messrs. E. James, Rowe & Co., for permission to break up the public highways in order to lay wires in them so as to light two establishments by means of one installation. The committee were of opinion that public highways should not be broken up for purely private purposes, and that upon a careful consideration of the whole question they were of opinion that the permission sought for should not be granted. It was urged that the applicants were large ratepayers, and that the policy suggested was rather narrow. What was proposed to be done would occupy a very short time, and if the roads were restored to the satisfaction of the officials, not the slightest inconvenience or loss would be sustained by the council. On the other hand it was pointed out that the Electric Lighting Company had obtained a provisional order, and that there were legal difficulties in the way of granting applications of this kind. In reply it was stated that the applicants did not desire to supply any other persons with electric light, and nobody could prevent firms manufacturing electricity on their own premises. Eventually the Council, by a large majority, agreed to a resolution stating that no objection would be offered to wires being laid in the public streets for lighting the applicant's premises, provided the streets were restored by the applicants to the satisfaction of the Council; that the electricity was used for lighting premises of the applicants only; and that the applicants undertook to remove the wires at any time on twelve months' notice.

Scarborough and Electric Lighting.—A special meeting of the Scarborough Town Council was held last Friday. Mr. E. H. Gawne proposed the adoption of the minutes of the Sanitary and Lighting Company, which contained a report of the Electric Lighting Sub-committee, the principal clauses in which were that Mr. A. A. Campbell Swinton, form a company to take over the powers granted to the Scarborough Corporation by their Electric Lighting Order, 1891, together with all the duties and liabilities of the corporation under that order, such company to be formed within a period of eight weeks from October 1st. The corporation also to have the option of acquiring the undertaking at the end of 21 years upon paying for the undertaking as a going concern, including the valuation of the goodwill (but without any allowance for compulsory purchase), such valuation to be made on the basis that the powers of the company would cease and determine at the end of the said thirty-second year, and upon the further basis that the dividead paid by the company shall be taken not to have exceeded a cumulative dividend of 10 per cent.; the amount of valuation in case of dispute to be settled by arbitration. The maximum price of current to the corporation for public lamps is to be 6d. per Board of Trade unit, such price to be reduced at the rate of one farthing per unit for each £1 per cent. per annum on the cumulative dividend declared above 8 per cent. per annum, after making allowance for such depreciation and reserve fund as before mentioned. The maximum price of current to private consumers to be 7d. per Board of Trade unit. The minutes were, after a little discussion, agreed to.

Removals.—We are asked to notify the change of address of Mr. Desmond G. Fitzgerald, from 46, Loughboro' Road, Brixton, S.W., to No. 94, in the same road. Mr. Fitzgerald's laboratory is at 75, Akerman Road, Brixton, and is devoted to experimental work in connection with secondary batteries, electrolytic "bleach" and alkali, and standard cells.

The London Battery Company, Limited, have removed to more commodious premises situate 1, and 2, Marlborough Street, Great Charlotte Street, Blackfriars, London, S.E., where all communications should be sent in future.

We are informed that Messrs. J. Sunderland & Co., have removed their works from Raven Street, Halifax, to more suitable premises situated at No. 183, Gibbet Street (late Lincoln Academy), where they hope to have the whole of their machinery in thorough working order within the next few days. Having increased their plant they are now able to undertake any description of high-class instrument work in addition to the ordinary patterns of telegraphic, telephonic, and general signalling appliances hitherto manufactured by the firm.

Messrs. Miller & Woods inform us that they have removed from 34, Gray's Inn Road, to 2, Gray's Inn Road (close to Holborn), in order to be able to obtain current from the Metropolitan Supply Company's mains. They are now installing the electric light at 142, Harley Street, W.; 15, Weymouth Street, W.; 8, Upper Wimpole Street, W.; 52, Mansion House Chambers, E.C., these with incandescent lamps; and 8 Brockie-Pell arc lamps in the Lewisham High Road near Lewisham Road Station.

Pretoria Electric Lighting.—In our City Notes columns will be found a copy of the report of the directors of the Pretoria Lighting Company, which is somewhat interesting. From the remarks regarding the extension system, however, it might be supposed that the fact that the original system of distributing the mains was unsatisfactory or unworkable, was due to Messrs. Crompton & Co.'s design being defective, but they ask us to point out that that design was not drawn up by them or by anybody over here, but by the original engineer of the Pretoria Company, who has since ceased to act for that company. We venture to think that considering the great distance Messrs. Crompton are off from Pretoria, and the fact that all the machinery has had to be transported by means of bullock waggons, a distance of something like 170 miles up country, and the whole of the machinery having worked satisfactorily from the commencement, and that the contract was completed within a very short time of the specified date, may be taken to reflect some credit upon that firm as contractors, and great credit upon Mr. Cushny who was their engineer for the work, and who has since been appointed engineer to the Pretoria Company.

Electric Lighting in the West End.—Since our last report regarding the progress of electric lighting in this district, several further contracts are to be noted, among which we may mention one in the premises of Messrs. Louis Wolff & Co., 245, Tottenham Court Road, by Messrs. Smeeton & Page; one in the premises of Messrs. Davies & Co., 256, Tottenham Court Road, by Messrs. Rashleigh Phipps & Dawson; one in the premises of Messrs. Haywards, lace merchants, 168, Oxford Street, by Messrs. Graham & Biddle; and one in the premises of Messrs. Chas. Baker & Co., 194, Oxford Street, by Mr. A. W. Sclater.—Messrs. Barnes & Low are at work in the premises of the Belgravia Bakery Company, Limited, 140, Victoria Street, S.W.—Messrs. Gilbert & Co. are fitting up 40, Harley Street.—The Planet Electrical Engineering Company are at work on an installation at 43, Weymouth Street.—An installation is being put in Portman Mansions, East Street, by Messrs. Rashleigh Phipps and Dawson, while the Electrical Wiring and Fittings Company are putting in an installation at Nottingham Mansions, Nottingham Street.

Fleetwood and the Electric Light.—Regarding our several notes on the lighting of Fleetwood, we understand that the Highway and Lighting Committee have recommended unanimously to authorise the clerk to enter into correspondence with the following firms with reference to electric lighting, with the request for reports as soon as possible: Messrs. Hammond & Co., Mr. Thomas Barton, and Mr. E. J. Jennings. It was also determined that a special letter, with reference to reports already deposited, should be sent to the following firms: Messrs. Crompton, Messrs. Ferranti, Messrs. Gordon, the Brush Electrical Company, and Mr. J. K. Grindrod.

Tender Accepted.—At a meeting of the Southampton Town Council last week the Special and General Works Committee reported the receipt of a number of tenders for the fitting of the electric light at the Corporation Waterworks at Otterbourne, the protecting tender of the electrical engineer (Mr. Aldridge) being £318 16s. 3d. There were 25 tenders, ranging from £398 to £227 10s. the lowest. The council accepted the tender of Messrs. Statter & Co., who have the contract for the electric work on Southampton Quay, for £235.

Tenders Invited.—Among our advertisements will be found particulars regarding tenders which are being invited by the Corporation of York for electric lighting plant for illuminating certain streets. The latest date for the receipt of tenders by Mr. George McGuire, the Town Clerk, is November 21st.

Tenders Wanted—Burnley.—The date for sending in tenders for the electric lighting of Burnley has been altered. The latest date on which they must be sent to the Burnley authorities is October 19th instead of October 26th as previously announced.

Tenders Wanted—Dundee.—The Dundee Gas Commissioners are inviting tenders for work and fittings in connection with the electric lighting of Dundee. Further particulars will be found in our advertisement pages.

Telescopic Extension Ladders.—A silver medal has been awarded to Messrs. J. H. Heathman & Co., of Endell Street, for their telescopic extension ladders and convertible step ladders, and two gentlemen of the judging committee each ordered some of the ladders, viz., Mr. Thomas, on behalf of Her Majesty the Queen, for the Royal Gardens at Windsor, and Mr. Blair for the Duke of Sutherland's gardens at Trentham. Messrs. Heathman's medal is the highest award given for ladders.

Woodhouse & Rawson.—We are advised by Messrs. Woodhouse & Rawson United, Limited, that they have received official notice from the Lords Commissioners of the Admiralty, to the effect that their name has been placed on the Admiralty list of firms who may be called upon to tender for the construction of unarmed wood-built boats, and the supply of engines for the same.

Electro-Metallurgical Company, Limited.—A general meeting of the members of this company is to be held at the offices of the liquidator, Mr. John B. Arter, 26, Waterloo Street, Birmingham, on November 5th, 1892, for the purpose of showing the manner in which the winding up has been conducted, and the company's property disposed of.

Contracts Placed.—The contract for the supply of Brockie-Pell lamps for the extension of public lighting in the St. Pancras District has been placed with Messrs. Johnson & Phillips. The district to be lighted includes the Hampstead Road, High Street, Camden Town, and other principal streets in the neighbourhood.

Siemens Bros. & Co.—The Liverpool Watch Committee recommend that a contract be arranged with Messrs. Siemens Bros. and Co., Limited, for hiring 50 signal lamp posts, also for the use of one office indicator for receiving messages from the lamp posts. These are for the Liverpool police signal system.

Change of Partnership.—Messrs. Swinburne & Co. inform us that Lord Russell has ceased to be connected with them, and that Mr. Bertram R. Beale has joined the firm, which will continue to carry on business under the same name as heretofore.

Chatham and Rochester.—An order for the supply of alternate current generating plant and transformers for the Chatham and Rochester electric lighting station has been placed with the Brush Electrical Engineering Company.

Grafton Galleries.—Messrs. Pyke & Harris have secured the contract for the whole of the wiring and fittings for the above galleries—239 lights.

Hospital Electric Lighting.—The Royal Aberdeen Infirmary which has been rebuilt and extended, and which was opened on Tuesday last by the Marchioness of Lorne, is fitted with a very complete electric lighting installation. The whole of the work has been erected to the specification, and under the supervision of Prof. Andrew Jamieson. The multitubular boilers are by Messrs. Babcock and Wilcox, Limited, and are fed by Messrs. J. H. Carruthers and Co.'s duplex pump, and a complete range of Messrs. Green and Sons' fuel economisers. The engines are of Messrs. Marshall, Sons and Co.'s manufacture. The dynamos as well as the whole of the electrical plant and fittings were supplied and erected by Messrs. J H. Holmes & Co., of Newcastle. The latest pattern of the Electric Power and Storage Company's cells (or K type) have been supplied. We understand that during the progress of the work Mr. Norman Whitelaw, a former student at the Glasgow and West of Scotland Technical College, acted as electrical and mechanical inspector.

Electric Lighting of St. Helens Town Hall.—Messrs. J. D. F. Andrews & Co. ask us to state, in reference to our last week's note anent the lighting of the St. Helens Town Hall, that the whole particulars were not reported at the meeting of the Parks Committee, and consequently our note bears a light somewhat different to what the real circumstances present.

CITY NOTES.

Crompton & Co., Limited.

THE following is an abstract of a circular letter which has been issued to the shareholders by the directors:—

"It has been represented to the directors by several influential shareholders that the number of the preference shares of the company is entirely disproportionate to the number of the ordinary shares, and that rather than offer the remainder of the preference shares for public subscription, it will be a better course to raise the additional working capital required, by an increase in the number of ordinary shares. The directors, after careful consideration, have decided to adopt this view, and to recommend that the nominal share capital be increased to £300,000 by an issue of 22,000 ordinary shares of £5 each. The effect of this arrangement will be to give the members for the first time the opportunity of acquiring these ordinary shares, the whole of the previous issue having been allotted to and retained by the two original vendors. A preference in the allotment will be given to the shareholders thus applying."

The meeting was held yesterday at the offices of the company, Mr. R. E. B. Crompton presiding, in the absence of the chairman, Lord Emlyn, who had to attend a meeting of the Great Western Railway.

The SECRETARY (Mr. F. R. Reeves) read the notice convening the meeting, and

The CHAIRMAN, in moving the resolution, said the shareholders would have gathered from his remarks at the general meeting this year, that their business was steadily increasing, and fresh capital was consequently required. They were then invited to take up preference shares at a small premium, but the response to that had not been sufficient. They consulted with some of their most influential shareholders—some connected with the Stock Exchange—who advised the board to increase the capital by the creation of ordinary shares. They were probably aware that Mr. Albright and he (Mr. Crompton) who were the original partners in the private firm—were still the holders of the whole of the ordinary shares. They took the greater part of their payment in ordinary shares, believing it to be the best method of showing their full confidence in the future of the undertaking. They, as the ordinary shareholders, had been satisfied with their bargain, but the proposal to increase the ordinary shares certainly seemed to them to be rather hard upon them, and prejudicial to their interests; but after considering the matter, they—the largest shareholders in the company who paid cash—felt that the proposed issue of the ordinary shares would not only strengthen the position of the debenture shareholders, but would be a great advantage to the ordinary shareholders. There was no sign that the rate of increase of the company's business would alter in any way for the worse. During the last few months they had taken many important contracts, and felt sanguine of employing the works as fully in the future as in the past. What were the prospects of the ordinary shares earning dividends? The dividends he believed in the past were not a fair criterion of what they would be in the future. He pointed out how greatly their profits had been cut down in the past by attending to new inventions and building up the business to enable them to keep their position in the front rank of manufacturers. He could say with confidence, that never since the first commencement of the existence of Crompton's, had their plant or organisation been in such a position to carry on their work in an economical and satisfactory manner as at the present time. Their efforts during the past three or four years had been concentrated upon extending their business in all parts of the world, and the larger portion of their money and time had been spent in sowing seeds which they had yet to reap the harvest. He then read an extract from the report of the Pretoria Lighting Company (which appears in another column). The way in which the directors of that company spoke of Crompton and Company as contractors, was the way they were being spoken of by everyone. Their South Wales agent, Mr. Howell, was in America, and wrote to say that although the quantity of plant that they had been able to supply in America had not necessarily been very large, on account of their having to pay 40 per cent. *ad valorem* duty, still such plant as had found its way there had been of such a quality that their name stood so high with the Americans, that on all sides the question was being asked "Why did not Messrs. Crompton come over here? Why do not gentlemen who have made such a position for themselves on the other side of the Atlantic, come and manufacture within the United States?" From Mr. Howell's and other letters and proposals they had received from America it was evident that their reputation regarding the work turned out by their staff was very good. The directors, however, did not entertain the idea of issuing any considerable portion of the capital they were asking for for carrying out work in America, but it was evident that if American capitalists were prepared to supply the greater portion of the capital to enable them to extend their business to America, it would be a very unwise policy on the part of the board to refuse to entertain such evidently advantageous proposals, and it would be right of them to contribute a small amount. There was no doubt that that and other forms in which they would receive payment from their American Company would very largely increase their future profits, and, consequently, augur very favourably for very considerable dividends being paid to their shareholders. After some remarks regarding the acceptance of Lord Emlyn of the chairmanship of the company, and the benefit they would derive from having that gentleman in the chair, Mr. Crompton moved the resolution as follows:—"That the capital of the company be increased to £300,000 by the issue of 22,000 additional ordinary shares of £5 each, such shares to be numbered 8,001 to 30,000, inclusive, and to rank, as regards dividends, and in all other respects, *pari passu* with the already existing ordinary shares of the company, and the directors are hereby authorised to issue these new shares at such times and on such terms as they may think fit."

Mr. J. F. ALBRIGHT, in seconding the motion, said: "Without dealing as lengthily as the chairman has done upon the possible prospects of profit that may come to this company in the event of the works being started, either in conjunction with ourselves, or on any other basis, in America, we still think that leaving that out of the question the prospects of this company are very good. The signs of expansion which we have on all sides had, justify us in taking the step which we are now asking your sanction to take. I have much pleasure in seconding the resolution proposed by the chairman."

The resolution was put to the meeting and carried unanimously.

That concluded the business of the meeting.

The Brush Electrical Engineering Company.

THE third annual general meeting of the Brush Electrical Engineering Company, Limited, was held last Friday at Cannon Street Hotel, E.C., the Duke of Marlborough presiding.

The SECRETARY (Mr. B. Broadhurst) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, I am very pleased to see that there are present here such fair numbers to hear, and not only read, the statements that will be made by your board as to the condition of the company. I think it is a very good thing for a company that the shareholders should take an interest in its meetings, and not, because things are prosperous, leave matters entirely to the responsibility of the members of the board and a few members at a general meeting. The last time we met I had only been chairman of this company for a few months, having taken up that post on the resignation of Lord Thurlow, so that this is the first complete year I have had the honour of occupying the chair of this company. Therefore, it devolves upon me to pay somewhat more careful attention to the condition of the company than perhaps one would feel it his bounden duty to do as an ordinary director. Now, gentlemen, in drawing your attention to the leading features of our report and balance-sheet, there are a few remarks which I should like to make to you. In the first place, you will observe that your profit and loss account shows a gross profit of £55,757. I will not go into a careful analysis of how these figures are derived, because I should prefer to leave this to my co-director, Mr. Braithwaite, who will give you his idea of the incidence of these figures, and how they generally affect the balance-sheet, but will confine myself more to general remarks with regard to these matters. In the first place, remember that the particular feature in the balance-sheet of a company like ours, that requires very careful attention, is that we are essentially a trading or manufacturing rather than a commercial company. A commercial company's business settles down into a very secure form. Take the case of a bank. It has always its clients, whether trade is good or bad. To a certain extent a railway is the same, with its passengers, though they are somewhat more numerous in good times than in bad. That is a commercial company; but this is a manufacturing company, and its business depends on the prosperity of trade and a demand for the particular article of commerce which we manufacture. That brings me to the remark that the balance-sheet representing the affairs of a trading company requires very careful attention, and I think it should always set forth very clearly the exact condition of affairs with regard to almost every detail. There was a remark made by a shareholder last year with regard to our balance-sheet which I was not prepared to answer exactly at the time, but which has remained in my mind since. It was that there should be some sort of analysis of the statement in the balance-sheet of property, patents, and goodwill. You will observe that the entry in our last years' balance-sheet was £266,270 19s. 10d. I was asked why

that item was not divided, and I confess that at the moment I was not prepared to give an answer. Now, however, I have placed it before the directors, and we have discussed the matter at some considerable length, and the board has come to the conclusion that in another year we will divide out that item. I have no scruple myself in seeing it divided out as far as the condition of the company's affairs goes, because I honestly believe that the figures will represent good value. But it divides itself essentially into two values. It would not be right to suppose that that amount represented property solely, and it would be equally wrong to suppose it was all patents and goodwill, but there is this difference in a trading company, and it is that we essentially possess goodwill, which is a legitimate and tangible asset. At the same time it is an asset which is contingent; that is to say, it is contingent to your existing as a company and continuing in a good condition of trade. Supposing your trade fell off, as, for example, in the case of the silk industry in Coventry, there would be no goodwill, and therefore in the case of this company it is wise to attempt to discriminate between these items of property, patents and goodwill. Patents, of course, are to a large extent difficult to value, and therefore I do not see that we can discriminate entirely between the value of patents and goodwill. But in the next balance-sheet the board have consented to adopt this course. I hope to see a division of these items. This brings me to another remark which I wish to make on the general trading of the year. Now, gentlemen, whatever may be the condition of many industries in this country, and some, I fear, have languished a good deal, trade not having been as prosperous in many directions as we might hope, yet at the same time I think there is real and steady progress being made in this electrical industry. No doubt, to a certain extent, the industry is on its trial. If there were one or two electrical financial failures connected with these large central stations, I think it would create great nervousness; but, on the other hand, I see no necessity to have any such fear. As far as I myself am concerned with this large industry in the City, it affords to me complete satisfaction, and I see no prospect of any disaster or difficulty occurring. Therefore, seeing that the electrical industry is on an absolutely sound commercial basis, you, as a trading company, I think, have very good prospects before you. The result of this year's trading has been that you are the possessors of a certain abnormal profit this year—a profit which cannot be expected every year. That is to say, a large sum has been received on account of the City contract, and Mr. Braithwaite will explain to you how we, as a board, have dealt with the matter. We have taken a portion as profit and divided it in a certain way, which I think is quite legitimate; we have only placed that portion to the dividend fund which would legitimately represent the working profits of the year. Another portion of that profit has been used for writing off certain doubtful items and law suits, and Mr. Braithwaite will explain how these have arisen, and the reason the directors have used this money seems with the purpose of writing them off. Then another portion of the money has been set to a reserve fund, which appears in your balance-sheet. Therefore, taking the general condition of the balance-sheet as it stands, I think it compares very favourably with that of last year, and from many points of view, is much stronger. On the other hand, I am bound to point out that we cannot always expect to be in the same position unless the trade progresses. There are many competitors in this field, and there is no question about it, we cannot monopolise all the orders, and, in fact, we are obliged, in order to be in a prosperous condition, to have a very large turnover in the course of the year so as to be able to present you with what I call a favourable balance-sheet. All these things must be remembered, and it depends very much on the exertions of your officers and your board to be able to keep the company in the van of this industry. I must say I recognise that a great deal of work is thrown upon the prominent officials of the company in this respect, and in viewing the course of the work during the year I observe that a large amount of labour has been bestowed by them in trying to popularise the Brush Company with town councils and local authorities likely to go in for electric lighting, and I hope that members of this board will be able to assist in this direction. In fact, the directors of this company must look upon themselves to a large extent as principals in the business rather than sleeping partners, whose function is merely to audit accounts. It is a business which must essentially be pushed, and, under these circumstances, I think you have a very good investment for your money and a very good prospect before you in this industry. I will not go very critically into the balance-sheet, as I have asked Mr. Braithwaite to address you on that subject, beyond saying a few words on a certain point. The policy of the company is to concentrate all its works at Loughborough. The Falcon Works, which we possessed on the amalgamation brought about in 1889, are being proceeded with, and we hope in the course of the year to abandon the works in Belvedere Road completely, and carry everything down to Loughborough. Your board have visited Loughborough on several occasions this year. I was only able myself to visit it once, the other day, and I and your directors can speak most favourably of what you possess down there. The engines and dynamos which are being made for the City of London are of a most approved character, and promise to turn out everything that could be desired. The prospect with regard to orders is good, and several orders of importance are at present in hand. You will observe that your debenture stock issue has been converted in the course of the year, and that you are practically borrowing now a larger sum of money for the same amount of interest. The amount of the premium on the debenture stock has been added to the property, patents, and goodwill account, and no doubt it is legitimately goodwill. With regard to the work done for the City of London Electric Lighting Company, it, I believe, has met with the approval of that company in every respect, and I anticipate that we shall have no difficulty in carrying out the contract we have there. There will, I hope, be no losses of any sort. You will understand that in this industry one of the great difficulties is not to make a loss on a contract, because we are often obliged to undertake work in which there was no previous experience, and in which we have to compete with other firms ready to go in on the same basis, and sometimes the result cannot be foreseen with certainty. I am glad to say, however, that this is not a very frequent occurrence. We exhibited, as you will see in the report, at the recent Crystal Palace Electrical Exhibition, and that exhibit attracted very considerable attention from the public, and has done, I believe, considerable good in bringing the position of the company before the public notice. I would like to add a few words with regard to the question of our foreign business. The Australasian business promises, I believe, to give us a profit in future years—a tangible profit—and I think that business may progress. There is no doubt that our colonies ought to be good customers of this company. With regard to our Austro-Hungarian business, I think I may say that the undertaking at Temesvar has been acquired by the town for a fixed sum. I believe that negotiation is practically concluded, and that we may look upon that as an asset which has been turned into money. Mr. Garcke, your former managing director, and whom I am glad to think we still have as a director, has taken a great deal of trouble in the matter, and we owe him a very great debt of gratitude, because I do not think that anything could really represent a fair recompense to him for the enormous amount of trouble taken by him in connection with your Austro-Hungarian business. He has been instrumental in concluding this matter. With regard to the rest of your business at Vienna, we anticipate that the day will come when we shall be able to hand over that undertaking to what I will call a native organisation, and that we shall be able to obtain a sleeping interest in the same. There are so many difficulties and anxieties in carrying on an industry of that sort in a foreign country that we should like to see our work, if possible, all concentrated at home. I do not think I need keep you any longer, for I think I have told you fully the position in which we stand. We have every reason to be satisfied with the year's working; the balance-sheet speaks for itself; and with regard to the item of valuation of the properties and the goodwill of the company, that is an item which although it has descended to us from the amalgamation, I think thoroughly represents the tangible assets of the company. I have, therefore, every confidence in saying that I think you may be fully satisfied with the result of the year's working, and that the dividend which you are now to receive is one which has been honestly and fairly earned. It is now my duty to move the adoption of the report and accounts, and Mr. Braithwaite will second the motion.

Mr. J. B. Braithwaite, in seconding the resolution, said that in a trading company like this the balance-sheet might either be made the means of covering up the true position of the company or of exhibiting it. In the present case, he believed their balance-sheet was one which would bear the closest investigation, and the more they investigated it the better they would be pleased with it. In considering the profit and loss account he wished them to bear in mind the fact that to pay 6 per cent. on the ordinary shares for the half-year required £7,000, and to compare that amount with the sums which had been written off. If they thus compared those figures, they would see the amount of prudence which the Board had exercised. The gross profit of £55,757 had only been arrived at after making the most ample provision for anything that seemed at all likely to turn out unsatisfactory in future years. The initial payment for the large contracts in connection with the City of London Electric Lighting Company had been received during the year, and it therefore seemed to the board an opportune time to clear away anything in the accounts that might be of the slightest unsound character. They had written off £4,636 as provision against losses incurred on some orders that they had carried out in foreign countries. Those present knew that the financial condition of some of these countries had been somewhat unsatisfactory recently, and the board thought it better to take the bold course of writing off the whole of these losses. They had also written off the entire cost of the compound winding action, which was brought against them by Messrs. King, Brown & Co., namely, £2,861; made a provision of £4,000 for any possible further bad debts, although at present none were in sight; £1,000 had been written off the provisional order account and another £1,000 in connection with the opening of their showrooms in Regent Street and in the City. It would thus be seen that had the directors been so disposed they could well have paid a higher dividend. They were determined, however, not to increase the dividend from 6 per cent. until they saw they could maintain it at a higher figure. He thought the shareholders would agree with their directors in their efforts to place the company in a sound financial position. The standing charges had been increased by the cost of the exhibition at the Crystal Palace. The expenditure on this account, which came to £2,172 had been written off entirely this year, but he wished to remark that this exhibition had proved very valuable to the company, as it had helped to secure several orders for central station lighting. Then, again, there had been a very large increase in the item for staff bonuses. It gave him very great pleasure to see this increase from year to year, for by this proceeding, which, by the way, the shareholders had already sanctioned, the whole of the affairs of the company were placed upon the system known as profit-sharing. As yet only a moderate amount of progress had been made in this direction—there were 64 officers and employees on the bonus staff—but he hoped that before long the whole of the employees of the company would be thus financially interested in the welfare of the concern. He regarded this as the best possible way of dealing with the labour question, identifying the interests of the men with those of the company. Although, however, the standing charges had been thus increased, they would be considerably reduced when the whole scheme for the concentration of the works was carried out. Mr. Braithwaite then went on to refer with satisfaction to the conversion of the 6 per cent. debentures into 4½ per cents., and he next proceeded to point to the

thoroughly safe position of the company as evidenced by the stocks. Last year the goods in hand in process of manufacture, and materials in London, Loughborough, and other places were valued at £78,326; this year the amount was £77,990, or practically the same figure. The shareholders would thus see that the company had sold the whole of their output during the year; indeed, they had also disposed of £4,000 or £5,000 worth of obsolete material, which had been replaced by stock of the most modern kind and having a ready sale in the market. The expenses of the share and debenture issues, £1,743 6s. 7d., were very moderate in view of the extreme benefit which the company received therefrom. The amount of debenture stock mentioned as issued was £111,347, the total authorised being £125,000, and he wished to state that since the balance sheet was made up the balance had been issued and placed. The speaker then went on to explain the reason that the board had set a certain sum by as a reserve account in connection with the City contracts. They had, he said, undertaken to make machinery of a size which had never been attempted before, namely, to provide for 6,000 and 12,000 lights; dynamos of this special kind of a capacity of 3,000 lights only having been made before. Two dynamos, providing for 6,000 lights, had been completed to the full satisfaction of those concerned, and as this indicated that there was every probability that the larger machines would also turn out successfully, it was most likely that the money set aside would be available for dividend in future years. The contract with the City was for £293,000, and as only about £50,000 of this had as yet been executed, they had orders in hand to the extent of £240,000, which was a satisfactory beginning for the new year. Turning to the appropriation account, Mr. Braithwaite pointed out that the property account had been reduced by £3,000; the preliminary and other expenses by £800, and that they were carrying forward a balance of £753 These deductions were in addition to those to which he had previously alluded, and represented a sum sufficient to pay dividend on the ordinary stock of 4 or 4½ per cent. The board might have paid a larger dividend, but he thought the shareholders would see the advisability of making the financial position exceptionally strong, and not paying any dividend which could not be maintained in the future. He had every reason to congratulate the shareholders on the present state of things, for they were now fairly out of the wood, and had entered on the high road to success.

Replying to Mr. Fry and other shareholders,

Mr. BRAITHWAITE said the whole of the balance of preference shares were issued at par in one block, and the company had benefited by the way in which the shares had been placed.

The resolution was then put and carried unanimously, and the dividends recommended were afterwards declared, the proceedings terminating with a vote of thanks to the chairman and directors, proposed by Mr. Fry and seconded by Mr. Smart.

The Pretoria Lighting Company, Limited.

THE following is a copy of the directors' report to the shareholders in this company:—

"Your directors have much pleasure in submitting for your approval this, their third report on the affairs of the company, together with the balance-sheet and profit and loss statement made up to June 30th last, and the auditors' report on same. The contract for the station buildings was placed in the hands of Messrs. Murdoch and Haldane, who have executed their work in a most creditable manner and to the entire satisfaction of the board. Messrs. Crompton and Co., Limited, handed over the electrical machinery and plant on June 1st last. Your directors called in Mr. J. Hubert Davies, the well-known electrical engineer of Johannesburg, to inspect the whole of the works. Mr. Davies has sent in a preliminary report and will send in a final one after September 1st when the three months' trial of the machinery by the contractors is concluded. You will remember that Messrs. Crompton & Co., Limited, bound themselves under a penalty clause, to complete their works by March 31st last. As this was not carried out, this matter was also referred to Mr. J. H. Davies who advised your board that good and valid reasons had been advanced by Messrs. Crompton & Co., Limited, for the non-fulfilment of their undertaking. On the arrival here of Mr. J. Cushny (Messrs. Crompton & Co's. representative) it was discovered that the original system of distributing the mains was unsatisfactory and unworkable. A new plan had to be devised (involving an additional expenditure of something under £3,000), which your board sanctioned, and which is now nearly completed, whereby the distribution of electrical current is made available to every house within the boundaries of the city. The plant consists of five sets of boilers, engines and dynamos, together with 102 lamps for street lighting, with all poles, insulators, &c.; about 36 tons of copper conductors, distributed on the underground and overhead systems, and with all necessary instruments required for a central station. Your directors think that the company can congratulate themselves on possessing one of the most thoroughly equipped and efficient stations in existence at the present time. It can be mentioned that the plant is capable of supplying current to about 6,000 lamps of 8 C.P. capacity, in addition to the energy required by the Government for the public lighting contract. The company commenced on June 10th last the supply of light to 48 of the public lamps, the Staatsdrukkerij (State printing office) and to a few private consumers. The whole of the public service could not be started simultaneously as a certain number of the lamps are on the extension system which will not be finished until September 1st. Up to date 72 private installations have been or are being connected to the company's mains. Your directors have secured the services of Mr. John Cushny as resident engineer, the appointment to date from September 1st, 1892. Your directors have also appointed Mr. Hirschel Cohen to the dual position of Manager and Secretary. Messrs. C. Hanau and J. B. Taylor retire in order of rotation, but are eligible, and offer themselves for re-election. You will be asked to appoint a new auditor or auditors in the place of Messrs. Cowen and Wilkinson, who have left the State; and to confirm the appointment of Mr. A. Scott Rankin, who was chosen by your board to conduct the audit of the accounts now before you and to fix the remuneration for same. The statements, as laid before you, need hardly any comments. From the profit and loss account you will learn the revenue and expenditure from electrical supply for the twenty days' work during the month of June (and one or two special services); but as few private installations had then been effected, and as the Government were only charged half of the contract price, the details are no guide to the proportion of revenue to expenditure. You will also notice that the amount of £3,346 7s. has been carried to preliminary expenses account. Your directors have decided that the amount of £4,543 expended during the past three years (including an amount of £1,741 taken over from the old Z. A. E. M.) on the various items affecting the formation of the company, and other amounts not directly chargeable to the construction account, shall be written off over a course of seven years, and the amount that will consequently be charged annually to profit and loss account will be £649 0s. 10d. Your board are happy to be able to state that the prospects of the company are favourable in the extreme. The popularity of the new light is evidenced by the daily applications for current from the public, and your board will make every endeavour to maintain that popularity by meeting the consumers in every possible way, feeling that the interests of the shareholders and the public are inseparable, and are even now considering a scheme whereby the advantages of the electric light will be brought home more clearly to every householder. It must be stated that the operations of the company has been inaugurated in a most auspicious manner. It is almost without record in the electrical world that an installation of the magnitude possessed by this company, should have started and worked so smoothly, successfully, and without a single hitch, as has been done in these works since June 10th last. We feel confident of being able to present the record of a profitable year's work by the next general meeting."

Official Announcements re Companies. — Last Tuesday's *London Gazette* contains an announcement to the effect that the following companies have been struck off the register:—Bournemouth Electricity Company, Limited; Telephone Union, Limited; United Kingdom Telephone Union, Limited. It is also announced that the following companies will be removed from the register in three months from 4th inst., unless cause is shown to the contrary:—Devon and Cornwall Electricity Supply Company, Limited; Douglas Patent Clock and Electric Meter Company, Limited; Jensen Electric Manufacturing Company, Limited; Kingston-upon-Hull Electric Lighting and Supply Company, Limited; Leicester Electric Light and Power Company, Limited; Liverpool Central Hydro-Electric and Massage Company, Limited; Patent Self-Binding Telegraph Insulator Company, Limited; Schoth's Electro-Medical Apparatus Company, Limited; Series and General Electric and Traction Company, Limited; Sunderland and District Electricity Supply Company, Limited.

Brazilian Submarine Telegraph Company, Limited. —We are informed that the accounts of this company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 3s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended June 30th, 1892, and also the payment of a bonus of 1s. per share, both free of income tax, which together will amount to £26,000, leaving a balance of £43,073 8s. 5d., of which amount £40,000 has been placed to the reserve fund, increasing that fund to £579,714 6s. 1d. and 3,073 8s. 5d. carried forward. For the purpose of paying the above dividend and bonus on the 20th instant, the register of transfer will be closed from the 10th to the 19th instant, both days inclusive.

Reuter's Telegram Company.—The directors have declared an interim dividend of 5 per cent. per annum, free of income tax, for the half-year ending June 30th.

Telephone Company of Austria.—The usual half-yearly dividend, at the rate of 6 per cent. per annum, is announced on the preference shares, payable forthwith.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 2nd, 1892, amounted to £786; corresponding month, 1891, £748; increase £38; total receipts to date, 1892, £10,757; corresponding period, 1891, £9,874; increase £883.

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts for the month of September amounted to £3,100, as against £3,055 in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of September amounted to £2,011, against £2,004 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The traffic receipts for the month of September amounted to £55,710, as against £56,539 in the corresponding period of last year.

The Great Northern Telegraph Company. The traffic receipts in September, 1892, amounted to £24,000. 1st January—30th September, 1892, £199,600; corresponding months, 1891, £213,400; corresponding months, 1890, £206,800.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 30th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, amounted to £3,613.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation September 29th.	Closing Quotation, October 6th.	Business done during week ending October 6th, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 –103	100 –103	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	48½ – 49½	49½ – 50½	49½	49½
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	89½ – 90½	90½ – 91½	91	90½
2,876,140*l*	Do. do. Deferred	Stock	9¾ – 10½	10½ – 11	10 7/16	9¾
130,000	Brazilian Submarine Telegraph, Limited	10	11 – 11½	10¾ – 11¼	11¼	11
53,200*l*	Do. do. 5 p. c. Bonds	100	100 –103	100 –103	...	..
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 –107	103 –107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞ – 3⅛	2⅞ – 3⅛	3⅛	3
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2 – 2¼	2⅛ – 2⅜	2⅜	2
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 – 4	3 – 4	...	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2⅛ – 3⅛	2⅛ – 3⅛	3	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	10¼ – 10¾	10 – 10⅛	10⅜	10⅛
$7,716,000	Commercial Cable, Capital Stock	$100	155 –165	168 –173	170½	170
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	⅛ – ⅜	⅛ – ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos 1 to 20,000	5	5½ – 5⅝	5 – 5⅛	5⅛	5
16,000	Cuba Telegraph, Limited	10	11½ – 12½	11½ – 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	17 – 18	17½ – 18½	18	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½ – 3⅝xd	3½ – 3⅝xd	...	...
6,000	Do. do. 10 p. c. Preference	5	9 – 10xd	9 – 10 xd	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜ – 11⅞	11⅜ – 12	11⅞	11⅜
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ – 15⅛	14⅞ – 15⅛	15 1/16	15
70,000	Do. 6 p. c. Preference	10	15½ – 16	15½ – 16	16	15⅝
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 –109	106 –109	10 3½	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	111 –114	111 –114	113	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛ – 15⅜	15¼ – 15½	15½	15¼
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	103 –106	1..3 –106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 –106	103 –106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	109 –112	109 –112	111	110⅛
122,400*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	103 –106	103 –106	...	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 –106	103 –106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	103 –106	103 –106	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	4¼ – 4⅜	3½ – 3⅝	4 3/16	3½
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	.. ..	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅝ – ⅞	⅝ – ⅞	⅞	1 1/16
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	2⅜ – 2⅝	2⅛ – 2⅜	2 5/16	2 1/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1⅛ – 1⅜	1⅛ – 1⅜	1⅛	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 – 3	2 – 3	...	.
180,227	Globe Telegraph and Trust, Limited	10	10¼ – 10½	10¼ – 10½	10 7/16	10¼
180,042	Do. do. 6 p. c. Preference	10	15⅜ – 15⅝	15⅜ – 15⅝	15½	15⅜
150,000	Great Northern Tel. Company of Copenhagen	10	18½ – 19	18½ – 19	18 1/16	18 1/16
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 –108	105 –108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	5½ – 6½	5¼ – 6½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½ – 10½	9½ – 10½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ – 22½	21½ – 22½	22⅜	21
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 –104	102 –104	...	...
17,000	Indo-European Telegraph, Limited	25	42 – 44	42 – 44	43½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ – 3½	2½ – 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 – 7	6 – 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 7/16 – 3 9/16	3 7/16 – 3 9/16	...	..
10,000	Do. do. fully paid	5	5 1/16 – 5 3/16	5 1/16 – 5 3/16	5⅛	4⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	6 – 7	6 – 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 –108	105 –108	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ – 7	6½ – 7	6⅞	6 13/16
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 –105	102 –105	...	...
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ – 4⅞	4⅜ – 4⅞	4⅞	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	13⅜ – 14½	13⅜ – 14½	14½	14 1/16
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13¼ – 13⅜	13½ – 14	13¾	...
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 –113	111 –113	112⅜	112½
48,000	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	1 – 1½	1¼ – 1⅜	1 7/16	1 3/16
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	4 – 4½	4½ – 5½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 – 5/16	3/16 – 5/16	...	...
10,802	Reuter's Limited	8	7 – 8	7 – 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅞ – 8¼	7⅞ – 8¼	8	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 – 8⅛	8 – 8⅛	8⅛	...
3,381	Submarine Cables Trust	Cert.	116 –121	116 –121	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3½ – 4	3½ – 4	3⅞	...
37,350	Telegraph Construction and Maintenance, Limited	12	44 – 46	44 – 46	45½	44½
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	103 –106	103 –106	...	..
58,000	United River Plate Telephone, Limited	5	1 – 2	1⅜ – 2¼	2 1/16	2
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 – 95	85 – 95	...	..
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ – 7½	6½ – 7½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	100 –103	100 –103	102	101½
30,000	West Coast of America Telegraph, Limited	10	3 – 4	3 – 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	102 –106	103 –107	...	...
64,242	Western and Brazilian Telegraph, Limited	15	8⅜ – 9½	8½ – 9	9½	8⅜
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6¼ – 6⅜	6 – 6½	6½	...
33,129	Do. do. do. 5 p. c. Deferred	7½	2½ – 3	2½ – 3	2⅞	2½
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 –106	103 –106	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 –106	103 –106	...	...
88,321	West India and Panama Telegraph, Limited	10	1 – 1½	1 – 1½	1 3/16	1⅛
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9¼ – 9⅜	9¼ – 9⅜	...	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8 – 9	8 – 9	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	103 –106	103 –106	104⅜	104¼
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	123 –128	123 –128	...	..
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	97 –102	100 –103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6 – 6⅛	6 – 6⅛	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. BANK RATE OF DISCOUNT.—2 per cent. (April 28th, 1892).

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid 7⅛—7⅜.—Electric and General Investment, shares of £5 (£1 paid), 2⅜—3⅛.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6¼—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2¼—3½.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5½, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅛—5⅜.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅛—5⅜.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—⅜.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—½.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—½.—Do. Debentures, 103—½.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ½—¾.—£5 Preference (fully paid), 2½—3.

FERROMAGNETISM.

Considering the great advances which have been made during the last 10 years in the experimental study of ferromagnetism, it seems highly desirable that its theoretical basis should be somewhat revised in its essential points. Kirchoff and Duhem have both treated the subject analytically; but H. E. J. G. Du Bois, in a recent issue of Wiedemann's *Annalen*, has followed a more geometrical method.

His paper is divided into four parts, viz.:

1. General vector distributions.
2. Magnetic „ „
3. Magnetic "circuits."
4. Finite cylinder.

Under the first heading is given a general discussion of these "distributions." The conditions are laid down for (*a*) solenoidal, (*b*) lamellar, (*c*) complex lamellar, (*d*) lamellar solenoidal ("Laplacian"), (*e*) complex lamellar solenoidal distributions. And the general propositions are—

1. If a vector fulfil any of these conditions, its product into a constant scalar quantity will fulfil it as well.

2. The superposition of two solenoidal or lamellar distributions gives a solenoidal or lamellar resultant respectively.

The second part of the paper commences with the proposition that the total intensity is lamellar. In the general case of variable susceptibility (homogeneous isotropic ferromagnetic medium, free from electric currents and hysteresis, numerical or directional), the lines of magnetisation must still coincide with those of total intensity; however, the magnetisation is proved to be complex lamellar (not "Laplacian," as in the old theory); the susceptibility acts as a scalar "integrating divisor."

The following theory holds, according to Du Bois:—Between any two points of the boundary between a ferromagnetic and an "interferric," the self-induced part of the rise of magnetic potential in the latter is numerically equal to the line-integral of the self-demagnetising intensity in the former.

The total induction has complex lameller-solenoidal distribution.

In case electric currents be following through the ferromagnetic, the distribution of intensity and magnetisation is no more capable of any particular specification; however, that of the induction remains solenoidal in this case also; the continuity of the flux of induction thus appears to be a perfectly general fundamental principle.

Lord Kelvin's theorems regarding similar electro-magnetic systems with currents proportional to the linear dimensions remain unchanged in this revised theory.

In discussing magnetic circuits, Du Bois makes the case of the split ring amenable to sufficiently rigorous treatment by the theory developed; he gives expressions for the value of the demagnet-ring factor, and for its relation to the coefficients which measure leakage.

In conclusion, Du Bois takes the experimental data of Ewing and Tanakadaté, and calculates from them a table giving the mean demagnetising factors for finite cylinders as well as those of the corresponding ovoids; for a given dimensional ratio the latter are always greater than the former; an ovoid behaving like a cylinder about 10—20 per cent. shorter. For cylinders exceeding 100 diameters the demagnetising factor becomes inversely proportional to the square of the dimensional ratio.

For this article we are indebted to an abstract by Du Bois communicated by him to the *Philosophical Magazine*; the original paper may be found, containing all details of the mathematical treatment, in Wiedemann's *Annalen*, xlvi., p. 485, 1892.

Dundee Electric Light.—Rules in connection with the distribution of the electric light, which is being introduced into Dundee, were last week issued by the Dundee Gas Commission, and along with them the charges for supplies are intimated. The price for electric energy up to 20 Board of Trade units is to be 8s. 4d. per quarter and 5d. for each unit above 20, while the rent for meters registering one unit per hour will be 4s. per quarter, the rate gradually increasing until for meters registering 15 units per hour the charge will be 12s. 6d. per quarter.

WATER POWER.

By E. TREMLETT CARTER.

(*Continued from page* 404.)

VIII.

27. *Water-Wheel Governors.*—The method by which water-wheels are automatically governed are as follows:—(*a*) mechanically, by connecting a centrifugal governor to the engine or to the dynamo; and (*b*) electrically, by controlling the supplementary gear by means of a solenoid placed across the terminals of the dynamo, the bars of the switchboard, or the feeding points of the circuit, in a constant voltage supply, or placed in the main circuit in a constant current supply. Centrifugal governors cannot at the same time be sufficiently sensitive and sufficiently powerful to be permitted to directly operate the sluices, but should be caused to act on some form of detaching and reversing gear, which, driven by the engine, will in turn act on the sluices. The manner in which this is done is illustrated by fig. 31. The governor balls are set in

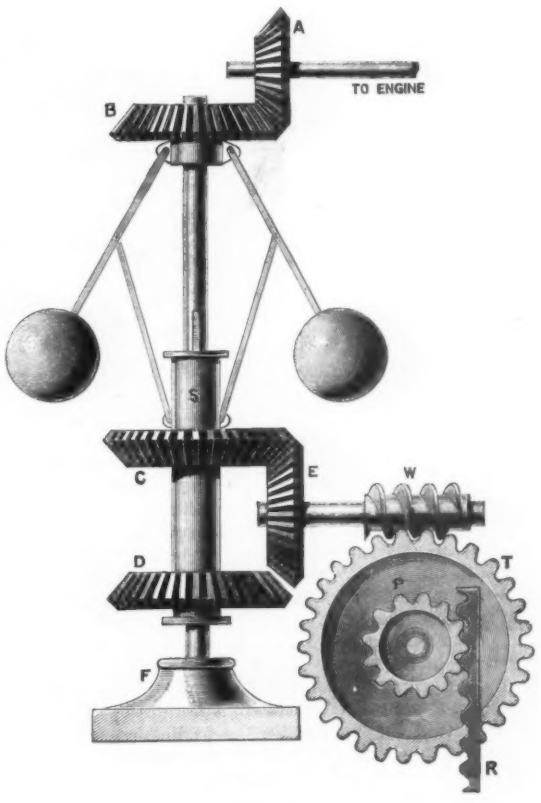


Fig. 31.

motion by means of the bevel gear, A, B, and lift more or less the sleeve, S, in proportion as the speed rises or falls. To this sleeve are fixed two bevel wheels, C and D, between which is a vertical pinion, E. When the speed is low, or the engine is not running, the pinion will be geared into the wheel, C; but when the speed has reached its proper value the sleeve will be lifted so that the pinion will be thrown out of gear. If, through any cause, the speed rises above its proper value the sleeve will be further lifted, and, should this become excessive, the pinion will be brought into gear with the lower wheel, D. The effect of this will be to set the pinion in motion again, but in the reverse direction to the motion caused by gearing into C. It will be seen from the figure that the pinion, E, actuates a worm gear, which in turn acts on the rack attached to the sluice. When the pinion is in gear with the wheel, C, the motion of the engine causes the

sluice to be further opened; while, when it is in gear with D, the sluice is being closed. The limits of speed when the engine is at full load, and when it is running light, provided there is sufficient water, will be the two speeds at which the pinion will gear into the wheels C and D respectively; but these speeds will only be temporary, for the governor acts in such a way that the pinion always tends to be thrown out of gear. The permanent limits of speed are consequently much nearer, and are the speeds at which the pinion is just *not* in gear with the wheel, C or D, respectively; they may be as close as to allow of a fluctuation of only two per cent. in the speed. A form of centrifugal governor which is sometimes used for water-wheels, but which is specially designed for turbines is shown in fig. 32. When the spur wheel in the right hand corner is in gear the governor operates the sluices in the manner described, but by throwing this out of gear, the sluice may be opened or closed by hand, by means of the hand wheel at the top of the vertical spindle.

Fig. 32.

Electrical governors have not been much in use for water-wheels in this country, though they have found favour in the case of turbines; they are used largely in America for both classes of engines. In electric lighting circuits the proper point from which to regulate is evidently the feeding point, for it is here that the E.M.F. is to be kept constant. By running a pair of pilot wires from the feeding point to the governor, the speed of the engine will always and at all loads be such that the voltage at the feeding point is constant. The manner in which the solenoid operates the sluice is substantially the same as in the centrifugal governer, the solenoid attracting more or less a vertical plunger which takes the place of the sleeve in fig. 31.

28. *Turbines.*—The form of water-power engine known as the turbine is rapidly taking the place of the water-wheel, and utilising falls which no water-wheel would be capable of working. While water-wheels have never been built for falls exceeding 80 feet, and are not generally suited to falls exceeding half that figure, turbines are now working at falls of from 1,600 to 2,000 feet, and it commonly occurs that a turbine is required to develop a fall of between 100 and 300 feet. And while capable of being adapted to these high falls, turbines are equally fitted to take the place of water-wheels on low or moderate falls, developing in them more power with less water and less space for machinery. A turbine may be defined to be an engine in which the water is guided in such a manner that work is done by the impulse of the entering water, or by the reaction of its discharge. We may therefore divide turbines into two classes—impulse engines and reaction engines. While it is true that in both these classes the work is done by the water on account of the reaction due to its change of momentum, it is, in a narrower sense, correct to apply the term *reaction* to those engines only in which the work is done entirely in virtue of the relative momentum of the stream of water leaving the engine. Considering reaction engines in this special sense, we shall find that no provision is made in them to guide the water into the engine along any particular and efficient path, but that the entire action is dependent on the manner in which the water is guided *out* of the engine. In the class of *impulse* engines we find that the reverse is the case, and that the work done by the water in the turbine is dependent on the manner in which the water is guided into the engine, all or most of the work being done in virtue of the impulse of the entering stream. These differences of action also give rise to important differences in the treatment of the head where the water enters the engine. In impulse engines it is essential that the head at this point shall be as largely as possible a head due to velocity, in order that the impulse may be large and efficient; while in reaction wheels the head at that point may be only slightly due to velocity, the proportion in which it takes this form having no effect on the efficiency of the engine. While remembering, then, that all turbines derive their effect from the reaction of a change of momentum in the stream, we shall find it convenient to consider a class in which the questions of the magnitude and direction of the velocity of the entering stream affect the efficiency of the engine—called impulse turbines—and a class in which the efficiency is not affected by these questions, but is determined by the relative momentum with which the water is thrown from the engine—called reaction turbines.

29. *Action of Curved Vanes.*—In considering the Poncelet wheel (par. 25) and the theory of impulse (par. 19), we have seen that a stream of water gliding on to a curved vane will exert a pressure on the vane which may enable it to move against a resistance and to do work. The proportion which the work done will bear to the original kinetic energy of the stream will depend on the magnitude of the component of its velocity in the direction in which the vane is moving, and on the absolute velocity with which it leaves the vane. To obtain a large proportion of work the motion of the entering stream must be as nearly as possible in the direction in which the vane is moving, and the velocity with which it leaves must be low. An examination of fig. 33 will enable one to see that these two considerations are really related. Let N, P, be the curved vane on to which the water is to glide, and let A, B, be the direction in which the water is moving, the velocity of the water being represented by the portion O, P. Then the component, O, H, is the velocity in the direction in which the vane is moving, and the component, O, V, is the

velocity with which the water traverses the vane in a vertical direction. It will be evident that the velocity, O, V, represents an amount of momentum which cannot be usefully removed from the water by the action of a vane moving along a line at right angles to it; so the problem is to make O, H, as large and O, V, as small as possible. This will evidently

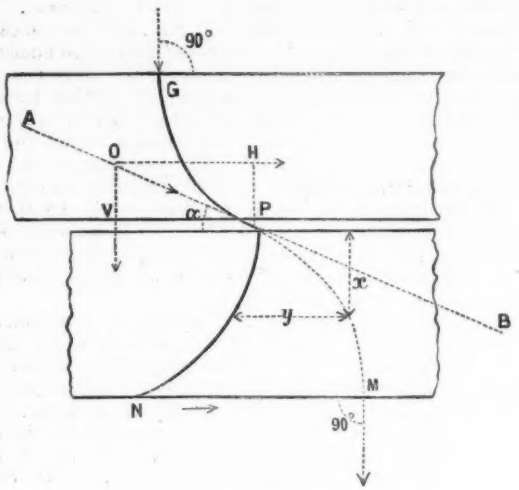


FIG. 33.

occur when the angle, a, is made as small as possible, the one component increasing and the other diminishing as the angle is diminished. The water should glide on to the vane at an entrance angle, a, which must be small, and should leave the vane at right angles to the direction in which the vane is moving.

During the time that the water is passing over the surface of the vane, the vane itself has been moving, so that the curve, P, N, does not represent the true path of the water, called the *absolute path*, but merely the path relatively to the engine. To obtain the absolute path we must compound the motion of the vane with that of the water, obtaining the curve, P, M. This curve is of great importance in the theory and design of turbines; while engineers whose business it may be not to build but to instal and use turbines, will find it advantageous to study its relation to the choice of engines. The absolute path in a well designed turbine will be a curve which makes the angle, a, at the point of entry, P, and a right angle at the point of discharge, M, the angles being measured with respect to the direction of motion of the vane. Apart from these considerations the shape of the curve is of little theoretical importance, and may for convenience be taken as a portion of a circle. It is usual to settle on the shape of this curve to commence with, and from it to determine the proper shape for the curved vane. Since the vane is moving with the velocity, v, in the direction, y, and the water is moving with the velocity (V . sin a) in the direction x, we have

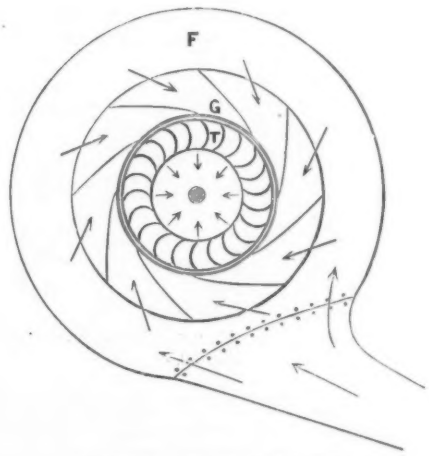
$$v : y = (\mathrm{V} \cdot \sin a)\, x$$

from which

$$y = \frac{(\mathrm{V} \cdot \sin a)\, x}{v}$$

The curve which the vane should have in order to produce an efficient impulse, depends, therefore, on the absolute velocity and direction of the entering stream, and on the peripheral velocity of the vane. Each different relation between these three quantities involves a different vane, otherwise a lower efficiency. If a vane constructed for a given velocity is run at a different velocity, or if when constructed for a certain head it is run under a different head, the result will be loss of power and unsatisfactory running. The moral of this is obvious: do not use stock or secondhand turbines, unless you are satisfied that the fall and power for which they are built, are identical with the fall and power which must be developed at the mill site in which you propose to place them. Secondhand steam engines may be, and often are, as good as new ones, and can be adapted to different conditions of work or different pressures of steam without alteration of structure or loss of efficiency. Not so with turbines, for these must be specially constructed to be adapted to the environment in each and every case. The "unco' cheap" turbines on the market which are manufactured in stock sizes, and in which the vanes for every condition of head are cast in the same mould are to be avoided, for the high efficiency with which they are credited can only be realised under conditions which would probably not be obtainable in practice.

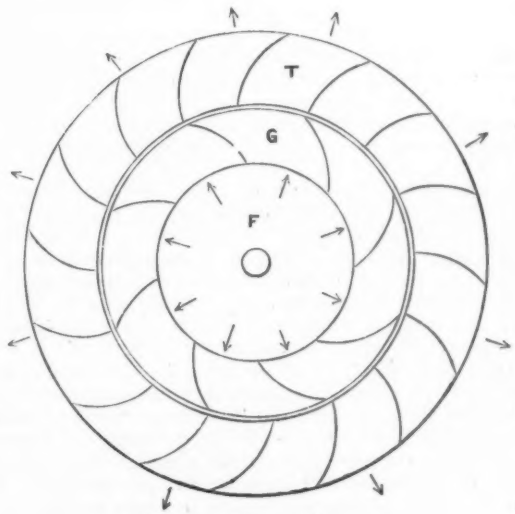
In order to convey the water from the supply pipe on to the vane at the right angle *guide blades* are used. These are curved blades or vanes which are fixed in such a manner that the water passes from the supply pipe on to them without shock or contraction, glides along them with a gradual



F, flume; G, guides; T, turbine vanes.

FIG. 34.

change of direction, and leaves them at a point close to the moving vane at the angle, a. One such blade is shown in the upper part of fig. 33 at G, P. A turbine is composed of a number of guide blades set into a fixed trough, dividing it into a number of guide channels and a number of vanes set in

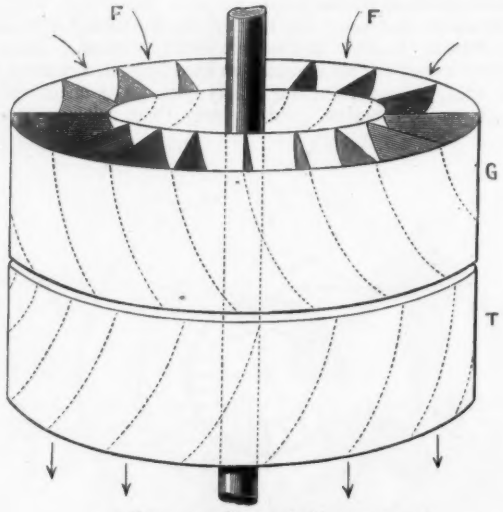


F, flume; G, guides; T, turbine vanes.

FIG. 35.

a moving trough. If these two troughs are arranged in the plane of motion of the engine, so as to form two concentric rings, the turbine is known as a *radial flow* engine; and this becomes an *inward flow* when the water passes from the outer to the inner set of curved blades, and an *outward flow*

when the guides are in the innermost ring. The arrangement for inward flow is shown in fig. 34, and for outward flow in fig. 35. Where the two sets of curved blades are in parallel planes, so that the water passes from one to the other along a line parallel with the axis of motion, the engine is called a *parallel flow* turbine, the general arrangement of which is shown in fig. 36. A combination of these occurs in some of the best turbines, and is known as *mixed flow*. In



F, flume; G, guides; T, turbine vanes.

FIG. 36.

jet turbines we have a form of *tangent flow*, in which the water is guided into the turbine along a tangent to the direction of motion, and passes off over a tangential plane.

The supply of water should approach the guides with a very small velocity, otherwise it would not equally distribute among the guide channels and the engine would be liable to get hot at the bearings. To provide for this the supply pipe is led into a large tank or an enclosed case, called a *flume*, in which the water lies almost motionless before passing into the guide channels. The enlargement from the supply pipe to the flume should, of course, be gradual (see paragraph 14). After passing through the engine, the water may either be discharged straight into the tail race, or pass through a suction pipe before being discharged. In the former case, if the engine is placed in the tail water, so that all its passages must be filled with water, it is said to be working *drowned*; while if it hangs free of the tail water level, there being, even with full load and the heaviest backwatering, a clearance beween the vanes and the tail-water, the engine is said to be working *not drowned*. By a special arrangement of force pumps, invented by Girard, it is possible to keep a turbine below the level of the tail-water without flooding the passages with dead water, air being pumped at high pressure into the spaces to keep the dead water back. Such an engine would be working *not drowned* below the tail water. With a suction pipe the passages must always be filled with water; and thus, though above the tail-water, the engine which has a suction pipe is really working drowned. The advantage of burying the engine in the tail-water, lies in the reduced weight of the parts when immersed in water, and in the possibility of discharging the water both upwards and downwards from the engine, thus balancing the reaction-thrust of that discharge; the disadvantage lies in the reduced efficiency at partial gate, for the dead water which flows into and fills up the spare places in the engine, acts as a check to the entering stream and a load on the moving parts. This will be discussed more particularly in a later section.

(To be continued.)

Manchester Association of Engineers.—On November 12th, Mr. B. H. Thwaite, A.I.C.E., of Liverpool, will read a paper before this Association, on "Economical possibilities of the generation of electromotive force in the coal fields, and its application to industrial centres."

THE RIVAL THEORIES CONCERNING THE NATURE OF SOLUTIONS.

STUDENTS of physical chemistry are aware that the points of contact between pure physics and pure chemistry are very numerous. There exists, as it were, between their domains, a borderland, of variable extent, within which each of these sciences may be said to possess a sphere of influence. The discovery by Mendeléeff (or Newlands?) of the so-called "periodical law of elements," has called into action numerous researches, some of which have accumulated correct numerical data to express the inter-dependence existing between the physical properties of various bodies and their chemical constitution, whilst others have had for their object the interpretation of this periodicity in the properties of the elements, under the assumption of their compound nature.

On the other hand, the development of the mechanical theory of heat, and the interest which has been awakened in electricity, have given rise to numerous researches aiming at a representation of chemical reactions as mere transformations of heat, energy, or electricity.

No portion, however, of the mysterious borderland of physics and chemistry has lately been so much under exploration as that which represent the nature of solutions. In 1890, alone, the committee appointed by the British Association for reporting on the bibliography of solutions, catalogued no less than 255 papers which appeared during that year in certain scientific periodicals. The total was at that time nearly 1,000 papers, and the number must be vastly greater now, for since 1890, the activity of investigators in this direction has been almost feverish.

We know no general review of the knowledge which exists of the nature of solutions which might be recommended to our readers, but if they search the back numbers of the ELECTRICAL REVIEW, they will find all the more important papers noticed, in some cases at considerable length. The address delivered by Prof. Orme Masson before the Australian Association for the Advancement of Science, in January, 1891, Prof. S. U. Pickering's Report to the British Association, in 1890, on the hydrate theory of solution (which was followed by an interesting discussion between Profs. Gladstone, Arrhenius, Armstrong, Fitzgerald, Van't Hoff, Lodge, Ostwald and Ramsay), and the elaborate report by Mr. W. N. Shaw on electrolysis (*vide* British Association Reports, 1890, Leeds), are excellent sources of general information. But, perhaps, Mendeléeff's foot-notes, in his remarkable "Principles of Chemistry," published in London last year, are, on the whole, the best means for gaining a general and impartial insight into the whole question. Though himself one of the earliest promoters of the hydrate or chemical theory of solutions, he fully recognises the importance of the physical theories, and sums them up with his usual clearness.

The researches of Van't Hoff, Van der Waals, Clausius, Raoult, Arrhenius, Ostwald, and others have by their results given great impetus to the propagation of the physical theory of solutions. A school of most enthusiastic supporters, headed by Ostwald, has grown up, and this school, while bringing out a mass of important researches and widening the field of chemical investigations, has come to consider itself as being on the right track for elaborating a complete theory of the subject.

But, as Prince Kropotkin, in a recent article in an American contemporary, to which we are much indebted, said, the followers of this school attach a secondary importance to the chemical forces which enter into play; forces which are, perhaps, quite as, if not more, energetic than the physical forces present. This would be quite incomprehensible were it not for the hope cherished by the adherents of the physical theory, of ultimately explaining all chemical processes by certain molecular movements (dissociation).

In order to account for the effects of the chemical reactions, the dissociationists, as they are generally called, are compelled to seek support in an additional agency—electricity. Starting from the familiar fact of solutions being decomposed by an electric current, they admit that in every solution, part of its molecules dissociate, breaking up into their component parts (ions), which are charged with either positive or negative electricity. By means of this admission, and making use of the dual theory of the nature of elec-

tricity, they attempt to explain the discrepancies between observations and the conclusions that can be drawn from certain well-known laws, especially in the case of aqueous solutions of salts, acids, and bases.

It must be recognised that many important relations between electrical conductivity and chemical action have been brought out in this way by Arrhenius and his followers; and many discrepancies between the laws of Van't Hoff and Raoult, and the observed facts, have been explained. But it is also evident that once a partial dissociation of molecules is admitted, the whole question takes a chemical aspect, and in the opinion of many English scientists, reference to such an unknown cause as electricity does not simplify it.

Most of our readers will be inclined, probably, to take the middle view, and to consider that neither the chemical nor the physical theory of solutions has yet succeeded in successfully grappling with all the phenomena that have been observed.

The subject has been immensely widened of late by the researches of Messrs. Heycock and Neville, of Prof. Roberts-Austen, of Messrs. Picton and Linder, and others, and we see in these much promise for the future.

Looking at the rapid accumulation of experimental data relative to the subject of solutions and the various theories already germinating, we may reasonably expect that the day is not far distant when a complete theory of the observed phenomena will be possible. Meanwhile we shall maintain our own attitude towards the question, noting each fresh research, whether its results make for or against any particular theory of any particular school of thought.

NEW PATENTS—1892.

16,692. "Improvements in electrical apparatus for signalling or speaking between ships at sea, or between ships and the shore, &c." S. F. WALLNER. Dated September 19th.

16,700. "Improvements in electric fire alarms." R. WOOD. (Communicated by E. Hoyle, Russia.) Dated September 19th.

16,768. "Electrically controlled switching apparatus for telephone exchanges." R. PIPPETTE. Dated September 20th.

16,775. "Improvements in keys for opening and closing electric circuits." A. MARR. Dated September 20th.

16,786. "Improvements in fittings for the support of electric lamps." W. DEFRIES and V. I. FEENY. Dated September 20th.

16,794. "Improvements in signal telegraphy." C. V BOUGHTON. Dated September 20th. (*Complete.*)

16,805. "Improved portable electric search light apparatus." R. A. SCOTT. Dated September 20th.

16,820. "Improvements in telegraphic and telephonic apparatus for establishing communications between signal boxes and trains on the line." J. D. HICKMAN. Dated September 20th. (*Complete.*)

16,822. "Improvements in electrolytic apparatus." T. CRANEY. Dated September 20th. (*Complete.*)

16,833. "Improvements in and connected with break feed appliances for electric arc lamps." F. J. BEAUMONT. Dated September 20th.

16,866. "Improvements in electrode plates for secondary batteries." A. MULLER. Dated September 21st.

16,877. "Improved signalling apparatus for telephones." Sir C. S. FORBES. Dated September 21st.

16,878. "Improved plates for secondary batteries." E. BAILEY and J. HALL. Dated September 21st.

16,879. "Improvements in miners' electric lamps." E. BAILEY and J. HALL. Dated September 21st.

16,892. "Process and apparatus for the extraction, separation, and refining of metals by electrolysis." D. TOMMASI. Dated September 21st. (Date applied for under Patents Act, 1883, Sec. 103, April 1st, 1892, being date of application in France.)

16,893. "Process and apparatus for the extraction, separation, and refining of metals by electrolysis." D. TOMMASI. Dated September 21st. (Date applied for under Patents Act, 1883, Sec. 103, May 21st, 1892, being date of application in France.)

16,903. "Improvements in and relating to electric accumulators," H. H. LAKE. (Communicated by F. C. Jenkins, Germany.) Dated September 21st.

16,904. "An automatic switch for electric and other light applicable to a door. J. HOPWOOD. Dated September 21st.

16,906. "Improvements connected with audible telegraphs." R. R. HARPER. Dated September 21st.

16,919. "Improvements in and connected with dynamo-electric machinery, alternating current motors, transformers, manufacture of ozone and oxide of nitrogen, recovery of tin from scrap, electroplating with aluminium." J. SWINBURNE. Dated September 22nd.

16,934. "Improvements in voltmeters or electrical indicators." W. H. THOMPSON and R. THOMPSON. Dated September 22nd.

16,948. "A mode of, and means for, enabling boats to be propelled on navigable ways by electric energy." E DE PASS. (Communicated by E. Geisenberger, A. Sellier, and E. Guillemin, France.) Dated September 22nd.

16,964. "Insulating electrical conductors." S. PITT. (Communicated by E. C. Davidson, United States.) Dated September 22nd.

16,980. "Improvements in connections for electrical accumulators and other similar purposes." J. J. ROBINS. Dated September 23rd.

16,997. "Improvements in electric bells." T. G. USHER, R. USHER, and R. C. USHER. Dated September 23rd.

17,004. "Improvements in electric arc lamps." F. D'A. GOOLD. Dated September 23rd.

17,012. "Improvements in and relating to the distribution of electrical energy." G. WILKINSON. Dated September 23rd.

17,091. "Improvements in insulating and supporting electric wires intended to act as resistances." R. E. B. CROMPTON and H. J. DOWSING. Dated September 24th.

17,092. "Improvements in insulating and supporting electric wires intended to act as resistances." R. E. B. CROMPTON and H. J. DOWSING. Dated September 24th.

17,093. "Improvements in electrostatic measuring instruments." W. E. AYRTON and T. MATHER. Dated September 24th.

17,099. "An improvement in carbon electrodes." H. T. BARNETT. Dated September 24th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

1,049. "Improvements in the manufacture of dynamo-electric machines." S. Z. DE FERRANTI. Dated January 20th. In the manufacture of dynamo-electric machines in which the wrought-iron cores of the fixed magnets are held in place by casting upon them at one of their ends a cast-iron frame—so that their ends unite with the cast metal—the inventor, in order to ensure that the wrought-iron cores shall be secured to the frame in correct positions, first range them in place on the flat top of an iron bed which is placed at the bottom of the mould within which the frame is to be cast, and he fixes them firmly in position to this bed, preferably by clamp bars placed across the top of the iron cores and by bolts passed down through the clamp bars and through the bed. The sand mould is then made up above the bed, leaving so much of each wrought-iron core as is to be embedded in the cast-iron frame projecting up above the sand. Afterwards the bolts and clamp bars which retained the iron cores in position are removed, so that after the casting has been made they may be free to slide upon the bed as the casting contracts. The completion of the formation of the mould is then proceeded with. 6 claims.

1,051. "Improvements in electrical transformers or converters, and in their manufacture." S. Z. DE FERRANTI Dated January 20th. In converters in which two sets of bars or strips are passed through the centre of the primary and secondary coils, and are doubled over outside these coils so that each makes a complete ring, as described in patent No. 15,141, 1885. The inventor uses in each set a number of such bars or strips set side by side at a distance apart so that they form a series of iron rings with air spaces between them, as described in that specification. He also separates the two sets of rings one from the other, so that there is an air space between them, and he keeps the two sets at the proper distance apart, and the rings in each set at the proper distance from one another, by a division plate which has projecting from each of its sides a series of clips or sockets into which the sides of the rings are received.

1,051A. "Improvements in testing electrical transformers and dynamos during the manufacture of the same." S. Z. DE FERRANTI. Dated January 20th. In the manufacture of these machines, the inventor prepares a series of separate coils, which he tests separately and afterwards builds together. For separately testing each spiral coil, and for testing a number of such coils when they have been coupled together, he tests each inductively, so that it may be seen that it can stand the E.M.F. it will have to bear. 4 claims.

4,689. "Electric switches." C. E. CHALLIS. Dated March 16th. Consists of a trigger, catch or locking piece, which holds the contact bar, or its equivalent, until sufficient energy is applied to the handle and stored up by the driving spring to entirely overcome the friction of contact and ensure a quick "make" or "break," together with certain devices for tripping the locking piece when enough force for the stroke is accumulated, and the several modifications necessary to adapt the principle to various forms of switches. 1 claim.

21,245. "Improvements in electric alarm and call clocks." J. L. CLERC, J. PICKARD, and I. ROUGEANT. Dated December 5th. Is based on the principle of two circuit breakers, one of which is mechanical and the other automatic, setting at work one or more bells near or at any given distance from the apparatus. 2 claims.

21,870. "Improvements in voltaic cells or batteries." H. H. LAKE. (Communicated from abroad by E. A. Clark, of America.) Dated December 15th. Consists in the application of the electrolyte in the form of a powder enclosed between layers of paper or other porous material, so as to form a pad, which is arranged between the copper and zinc plates of the cell. 2 claims.

CORRESPONDENCE.

Magnetism and "Magnetism."

Of the four correspondents that have honoured with their criticism my articles anent Mrs. Besant's exposition in a contemporary, of hypnotism and mesmerism, I observe that two of them have qualified themselves to write the magic letters "F.T.S." after their signatures; a third states that "Mrs. Besant is by far the cleverest woman in existence;" and the fourth, whilst adopting a fairly tolerant attitude, fails in common with the others to understand my position. Anyone is at liberty to theorise, but if he wishes his theories to be taken seriously by intelligent men, he must at least be lucid, and he must avoid error and confusion.

It is obvious from their silence that the regular readers of the Electrical Review have entirely comprehended my meaning, and it has been left to persons who possibly only know the paper through press-cutting agencies, and who are of a certain peculiar habit of thought, to mould my remarks, as it were, into puppets at which they may hurl mere verbiage, so that they may exhibit at least a semblance of defence.

Whilst adopting a friendly attitude towards Mrs. Besant, and asserting that we believe her action to be inspired always by honest conviction, I took the liberty of indicating that in her treatment of her subject she misleads and confuses her readers by appropriating terms which are reserved for the present to designate or explain certain definite phenomena and by applying these terms to certain alleged phenomena which have not yet been proved to be of the same order. The same attitude might be adopted towards a person who, *e.g.*, writing a thesis on fishes, persists in calling some of them carrots, parsnips, &c.

Mr. Harry Austin invites me to explain what magnetism is. I will endeavour to do so when he explains to me what is gravitation. Until I can do so I must, he says, withhold my criticism, yet I venture to think I should incur his criticism if I were to state that an apple falls to the ground because it is red. He taunts "leading scientists" with not being endowed "with the same reasoning powers and the same determination that this lady (Mrs. Besant) possesses." It is unfortunate for the "scientists;" but I have already invited the lady to "settle down, say, to ten years of experimental research, and then bring forward her results and the theories she bases upon them."

I hold that up to the present no identity has been established between magnetism, as the scientific world understands it, and the "animal magnetism" about which the mesmerists, &c., talk. And, further, that whereas through experiment we have discovered certain relations and laws concerning magnetism, none have yet been in the same way deduced concerning "magnetism." Hence until the school of speculation to which your correspondents evidently belong come forward with a generalisation, based upon numerous experimental data, disclose to us the methods by which we, too, may verify their experiments (as every scientist now does), and absolutely proves the identity between magnetism and "magnetism," we shall still use the inverted commas.

Too much credulity appears to be required of us. We must have faith, sympathy, &c. Such a spirit of approaching an alleged science is worthy of the darkest days of that period of medical mysticism, between which and the present day a gulf of centuries is fixed. We physicists do not require "faith" from our hearers when we expound our theories; we describe our experiments, show how they may be verified, state our theories, and invite criticism, appealing thus to their reason, and not to (shall we say) their superstition; in short, we ask them to take nothing for granted that they cannot prove for themselves. We do not dogmatise even about the ether.

The dilemma which Mr. C. H. Collings, F.T.S., recognises, is of his own manufacture. Assuming that I do not know that there is no magnetism in the human body such as exists in a bar-magnet. Very well. I still say to anyone who *asserts* that there is, "You must not call it magnetism until you have proved it to be identical with that which, in the present state of our knowledge, we understand by that name." My position is still one of protest against the use of terms which are, or might be, unintelligible or misleading. And this position is not so "impossible" as Mr. Collings asserts. I may be "out of water," as he terms it. But if so, perhaps he is "out of his depth," and like the squid raises little clouds (of *ink*, too) to obscure his real position.

There is no use in dragging Chambers's Encyclopædia into the question, as Dr. Inglis Clark has not appropriated any of Mesmer's theory in his article on ether.

The only other matter of consequence in this correspondence is the reference to Dr. Luy's article in the *Fortnightly Review*. Mr. C. H. Collings, F.T.S., triumphantly points to Reichenbach. In one little footnote to this long article by Dr. Luy (p. 183), I find the following: "Reichenbach, in his experimental studies, already observed the fact that hypnotic subjects perceive flames at the poles of a magnet." This is how Dr. Luy describes his verification of this discovery:—

"You take, for instance, a large rod with three branches, and place it in a horizontal position, the north pole being directed towards the sensitive subject in a state of lethargy. After a few seconds the magnetic influence becomes manifest, the subject stretches his hand towards the magnet, takes it, and after receiving a slight shock which indicates that he is penetrated by the magnetic influence, he takes the magnet by the north pole and contemplates it with delight. He passes into the somnambulistic state, and then he speaks; he communicates his impressions and emotions. "'What do you see?'" you ask him, "'And why are you so pleased?'" "'I see flames,'" he says, "'flames of various colours, and I love to look at them. Oh! how happy I am. I feel so well; I should like to live always in this condition.'"

Again, on p. 183, he says:

"Here is an experiment which gives an idea of the excessive acuteness of sight developed in a subject in a somnambulistic state; for instance, I give a subject, Ch, 20 pieces of white paper, similar in appearance, at least to our eyes. I make a mark on the back of one of these pieces of paper, and I say to the subject in the somnambulistic phase: 'Look at this piece of paper; there is a design on it; it is the portrait of Mr. X. Look well, and tell me if you can see the portrait clearly.' This done, I shuffle the 20 pieces of paper, and I say to the subject, 'Amongst these pieces of paper tell me where the portrait of Mr. X is.' He examines them in succession, and when he reaches the one I marked on the back, he does not hesitate; he instantly points it out. This is another phenomenon of excessive acuteness of physical vision."

On page 169, we have the following: "Simple suggestions given to a patient appear with the same characteristics which belong to illusions and hallucinations. You tell a patient that he is in a garden, and he takes what you say as the fact; he believes that he is in a garden, and tries to pick imaginary flowers; or tell him he is near a watercourse, and you thus arouse in him an association of ideas—he wants to fish, to bathe, to row in a boat. In this there are genuine illusions of the patient's sight. You can in this stage change one colour to another—if you show him a yellow paper and tell him it is blue, he will agree with you. . . . In this manner various suggestions may be presented to him. . . . You may place a bottle of ammonia under his nose and tell him it is eau de cologne, and he will agree that it is; you may make him swallow a pellet of paper, telling him that it is mint, and he agrees and perhaps adds that it is rather strong mint."

More quotations might be given, but these tell their own story, and our readers will see what I wish to convey without any suggestion from me. There is, however, a remarkable statement in the first part of Dr. Luy's article (*vide Fortnightly*, Vol. I., 1890, p. 918), which is as follows: "To characterise this state of peculiar malleability of mind, which is only the ordinary credulousness carried to an extra-physiological pitch, the term *crédivité* has been invented. It is a principal characteristic of the somnambulist stage."

N.B.—The patient in the "Reichenbach experiment," as prepared by Dr. Luys, was in the somnambulist condition; so was the man who saw a portrait on a blank piece of paper. Surely, Mr. C. H. Collings, F.T.S., this *Fortnightly Review* article is a rather unfortunate reference.

With apologies for filling up so much space,

The Writer of the Leaderettes.